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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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IN THIS ISSUE

From All Quarters 552
Cranfield's Flight-Test Symposium 554
Missiles and Spaceflight 555
Flight System Survey 557
Mirage 558
Tyne 563
Sea Legs Over Britain 568
Straight and Level 569
Correspondence 570
Sport and Business 571
RAF on the Rock 572
Air Transport as a "System" 573
The Industry 574
Air Commerce 575
Service Aviation 580

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Convictions and Courage

IT has become evident that the planning of future weapons is no task for the chicken-hearted. The wrong choice can imperil national safety for years, to say nothing of wasting a fair proportion of the budget. Critical decisions should be made by very clever people indeed; but unfortunately, nobody is clever enough. It is beyond the power of any human being to predict how the military picture will change over the coming 12 months, let alone the next five years.

It follows that, when the lead-time is of the order of ten years, whoever has to order or reject can only take an immense gamble. At one time the Avro 730 seemed the logical successor to the V-bombers; but it was cancelled "having regard to the . . . likely progress of ballistic rockets. . . ." At one time the Arrow seemed the logical successor to the CF-100; but it was cancelled because "by the middle 1960s the missile seems likely to be the major threat." Once the B-70 seemed the logical successor to the B-52; but it was "reoriented to a prototype aircraft program" after the 1961 vote for it had been cut. At one time Blue Streak appeared the best delivery vehicle for our deterrent; but we are now taking an agonizing second look "in view of the immense technological changes taking place."

No nation has a monopoly in making mistakes. Some view the broad spectrum of American weapons with envy; but such results are gained only by a brute-force attack from all points of the compass. That technological strength is no guarantee of success is understood by the RCAF, who chose the Bomarc in place of the Arrow. Now this missile's repeated failure has clouded its own future.

We in Britain would do well to remember all this. The temptation to discard our own efforts in favour of a brochure from abroad can be dangerously tantalizing.

Primer for Planners

THE most misunderstood and misapplied expression in the morass of aeronautical terminology is "weapon system." Its impact on a lay audience is always a potent one, and can be vastly increased by the addition of "concept," which has a mystic symbolism of its own; and one has heard senior air marshals—without having the remotest notion of what they are talking about—discoursing upon and around the weapon system theme to an utterly subdued assembly. Nevertheless, as a contributor, J. E. D. Williams, remarks on page 573, the doctrine has opened the way to advanced technological solutions to operational problems. "One no longer decides," he says, "to build a faster bomber; design an aircraft in isolation from the rest of 'the system'; fasten on whatever seem to be the most suitable engines, armament, navigation and communications equipment independently designed by other people for unspecified vehicles; fill any remaining space with bombs; and finally hand over the result to military operators for any odd job they see fit. Nowadays airframes, engines, navigation (sometimes called guidance) and weapons are designed as components of a weapon system."

The interest of these observations, however, is not merely intrinsic. It is to be found more in their context; for our contributor's main concern is not armaments but air transport. To contemplate a design for air transport as a system in itself, he shrewdly observes, is meaningless, because a system must have a designed function. Even so, the aircraft and their environment (airports, air traffic control, ground operations, etc) do form a system, and in his contribution this week Mr Williams pleads for new thinking in this connection. Next week he will consider the requirement for a navigation/ATC/communications system in some detail. Having digested these two contributions, we believe, our transport planners will have one distinct advantage over the air marshals we mentioned earlier. At least they will know what they are talking about.

FROM ALL QUARTERS

Blue Streak Cancelled

ON April 13, the Minister of Defence, Harold Watkinson, announced that development of Blue Streak, the British long-range ballistic missile, is not to be continued as a military weapon. This brings to an unhappy close the history of our biggest weapon system, and the only one which could have opened the way to British participation in space exploration. A note on the latter aspect appears on page 556.

In the words of the Minister, "The Government has concluded that they ought not to continue to develop, as a military weapon, a missile that could be launched only from a fixed site. Some other vehicles would, in due course, be needed in place of Blue Streak to carry British-manufactured nuclear warheads. The need for this is not immediately urgent, since the effectiveness of the V-bomber force as the vehicle for these warheads would remain unimpaired for several years. On present information there appears much to be said for prolonging the effectiveness of the V-bombers by buying supplies of the airborne ballistic missile Sky Bolt. The Government understands that the US will be favourably disposed to the purchase by the UK, at the appropriate time, of this vehicle." (This was confirmed in Washington the following day.)

The first reaction to the news is that there has been a great scandal, and that fearful errors have been made; but hindsight is simple, and nobody can say that there have been any decisions which were wrong when they were taken. When Blue Streak was announced in August 1957 it was officially viewed as "our ultimate defensive weapon"; and three months earlier the Air Ministry, who state the requirement, regarded the ballistic missile as "close to the ideal deterrent weapon." What has happened to alter this view, and make the ageing Vulcans and Victors seem suddenly attractive?

The chief advantage of a strategic ballistic missile is that, in the present state of the art, it is virtually unstoppable. It is inflexible, cannot be recalled (although there is no reason why it cannot be destroyed by radio command), needs complex and expensive ground-support equipment, and usually has to operate from a fixed base. The vulnerability of that base can be reduced by hardening, i.e., by putting critical portions underground. There are many carefully assessed degrees of hardness, each representing given likelihood of remaining serviceable after a certain megaton explosion at a certain distance. Most Atlases and the Thor are soft; Titan is hard; and Blue Streak was designed to be very hard.

Cost of an emplacement depends critically on hardness stipulated, related to topography and strata at the chosen site. Degree of hardness is determined by the likely enemy warhead yield and CEP (circular error probability), and when all the sums were done in the summer of 1957 Blue Streak made perfect sense. The calculations have been done many times since, and Blue Streak has made less sense each time. As Mr Watkinson has pointed out, "In the Defence Debate last year (1959) . . . the balance just came down on the side of going on . . ." Now three factors have pushed the balance to the point where Blue Streak is no longer worth the money: increasing cost of the project as a whole; demonstrated Russian accuracy of a higher order over longer ranges than had been bargained for; and the likelihood of alternatives which do not need a fixed base.

Total cost of the programme to date has been about £65m. Some £600m would have been needed to complete development and put the agreed number of operational Blue Streaks in silos with the maximum degree of hardness in the chosen locations. According to Mr Watkinson, Sky Bolt will be available (to us) at the same time that Blue Streak would have been. Obviously we consider our money better spent in trying to preserve our independent deterrent with this American weapon, fitted with our own warhead and carried by Mk 2 V-bombers and, later, by a fleet of Britannic or "Super-VC10" bomber/transports.

THE PHOTOGRAPHER REGRETS that this picture of the Avon-powered Dassault Etendard, secured from "Flight's" Gemini, is on the hazy side, but explains that he took it in cloud. He regrets also that the Gemini's aileron obscures the nosewheel assembly. This he rectifies on p. 568

Air Entente

FOLLOWING Mr Sandys's discussions last week with the French Government, a joint communiqué announced plans for aeronautical collaboration on an unprecedented scale. Delegations had "discussed proposals for co-operation in the development and production of civil and military aircraft, guided weapons, and electronics equipment. In particular, the Ministers decided to promote collaboration in the development of vertical take-off aircraft. . . ." They approved "discussions taking place between firms in both countries with a view to . . . collaboration in the development of a supersonic civil airliner"; welcomed the progress made with the Eurocontrol system of ATC; and agreed to collaborate on an automatic landing system and to test certain French electronic devices at the RAE Bedford.

Hovering Into Practicability

BOTH British aircraft giants have hinted at their intentions of developing and exploiting hovercraft designs under the probable aegis of Hovercraft Developments Ltd. At Saunders-Roe, now part of the Westland Aircraft helicopter group, work is continuing on the development of Christopher Cockerell's principle which the firm pioneered.

Contractors for the Hawker-Siddeley Group, it was reported last week, are likely to be Folland Aircraft, and Vickers would fulfil a similar development-organization function for the British Aircraft Corporation. The results of negotiations between the last-named and HDL were expected to result in the early announcement of the establishment within the group of a hovercraft organization.

The Marboré-propelled Saunders-Roe SRN-1 should start its trials in May; before it does so, however, a ground-effect vehicle from another stable, G-APYH, the Norman-Britten C-1 Cushioncraft, may have been hovered out from its hangar at Bembridge. This design is a financially co-operative venture between Norman-Britten and Elders and Fyffes.

Rotary Round-up

WESTLAND AIRCRAFT announced last week that the consolidated assets of their group will be about £11.5m. They believe that the concentration on rotary-wing development within a single group "will lead to a much more logical and efficient programme and a substantial saving."

The consideration for the Bristol Division is the issue of 2m Westland Ordinary shares of 5s each and a cash payment of some £1.27m; net value of the division is about £2.77m (£112,000 land and buildings, £170,000 plant and machinery). The consideration for Fairey is the issue of a further 2m shares and a cash payment of some £1.35m; net assets are estimated to be £3m (£1.4m land and buildings, £267,000 plant and machinery). The Bristol Division's 192 Belvedere is in production, but manufacture of the Sycamore has ceased. Westland will make "a substantial contribution" to back up the Government development contract for the enlarged Rotodyne; production of the Gannet AEW.3 and re-conditioning of earlier marks for Indonesia will mean good business for two years, but no further fixed-wing contracts are expected.

Etendards at Bedford

BOTH the Atar- and Avon-powered Dassault Etendard IVs have successfully completed catapulting and arresting trials at the RAE Bedford in recent weeks. A naval strike aircraft, the Etendard IV is an enlarged descendent of the Etendard VI (Orpheus) which contended for the NATO strike contract.

Seven pre-production Etendards are being built. The 07 aircraft will be a reconnaissance version designated IVP, equipped also for tanker flying with a Douglas-designed hose-reel "buddy pack." All production aircraft will have a retractable refuelling boom housed ahead of the windscreen. The first Atar-powered production Etendard IVM for the French navy will be delivered in November 1961, followed by another 49 at the rate of four per month. A second batch of 50 is to be ordered later. The Avon-powered version is for export.

Last week *Flight* photographer Ian Macdonald flew with Mark Lambert in the staff Gemini to Bedford and took the air-to-air pictures of Etendard 03 reproduced here and on page 568. The 03, or Etendard IVB, has a Rolls-Royce Avon Mk 51 (200 series) giving 11,200lb thrust and adapted for flap blowing. Blowing is applied from slots aft of the drooping, dog-tooth leading-edge

and ahead of the outboard halves of the main flaps. The decision to fit the Avon was taken last April; the aircraft flew in November, and on its 30th flight was catapult-launched from Bedford. It is established that the Atar-powered IVM may be launched by the 150ft catapult of the *Clémenceau* with no relative wind. The IVB will be able to use the short 103ft catapult with 20kt ship speed but no wind. Mk 13 arresting gear will be adequate for landing, and at Bedford it was picking up the wire at 113kt some 15ft off-centre without ill effects. Powerful disc brakes with Ministop anti-skid gear and drag chute are fitted. The IVP will also have a tail-warning radar. Spoilers increase lateral control, and the leading edge can be drooped 15° for combat or 30° (plus 60° flap) for slow flying.

Possible roles include interception using the Aida fire-control for limited search and automatic tracking and ranging. Weapons would include the 2×30mm gun pack and four Sidewinders or two of the latter and two Nord 5103s. For ground-attack the Aida can be used for ranging for guns or bombs. Alternative loads are two 1,000lb and two 500lb bombs, or four packs for a total of 72×2.25in rockets. Four 130gal underwing tanks will allow a ferrying range of 2,000 n.m. For navigation, the Etendard carries Tacan and a Position and Homing Indicator.

Normal gross weight of the IVM, with 9,700lb-thrust SNECMA Atar 8, is 18,000lb and maximum gross 23,000lb. Operational ceiling is 50,000ft, and 40,000 can be reached in the interception configuration in 4min 30sec. Maximum level speed is M1.08 at 30,000 to 35,000ft and M1 can be very rapidly exceeded in a shallow dive. With the leading-edge drooped to the 15° combat setting, the Etendard can complete a loop starting at 250kt and pull 5g at 300ft. At 600kt it can roll in 3sec using the lateral spoilers.

Transatlantic View

TAKING *The Changing Pattern* as his title, Sir George Edwards put over some typically provocative ideas to a New York audience on April 7, after being presented with the Daniel Guggenheim Medal (the citation for which was announced in *Flight* for January 15). Referring to civil aviation, he expressed the view that its yardstick of service to the travelling public was being weakened by "this fetish of intense competition at all costs," instancing seven airlines competing on the New York - Washington route. He believed a united effort should be put into reliability, to beat all forms of delays; and there should be continued pressure for low fares, based on an economy class.

With all the money the airlines had invested in subsonic aircraft, the irresponsible entry of a supersonic transport would be the greatest possible disservice to the stability which aviation needed so badly. Sir George said that the thing which terrified him was that the Russians would come out with a supersonic transport. If they wanted to make an attack on the economy of the free world, they could do nothing better than prematurely introduce such an aeroplane.

In a reference to the aviation industry's new groupings in Britain, he commented that the strengthening that had come from the deployment of the best brains, and combined resources of several large companies, far more than outweighed any theoretical advantages they might have gained from competing with one another.

The presentation was made at an awards banquet of the Society of Aeronautical Engineers, under the chairmanship of the SAE president, Harry E. Chesebrough. Sir George, who followed Sir Geoffrey de Havilland in being the second British citizen in recent months to be honoured by a leading Americal technical society for distinguished aeronautical achievement, was introduced by Jerome Lederer of the Flight Safety Foundation; and at the close of the evening the toastmaster, William ("Banquet Bill") Littlewood, made a presentation to Lady Edwards in recognition of her support and encouragement for her husband's work.

"Flight" photograph

MOBY DICK: Having all the attributes of the mighty white whale of fiction, this production Handley Page Victor B.2 (four Rolls-Royce Conway RCo.11s) differs from the prototype in having an embryonic dorsal fin, with intake. Departure ex-Radlett—pilot, Johnny Allam

Sir Archibald McIndoe

WE record with regret that Sir Archibald McIndoe, KT, CBE, MB, ChB, MS, MSC, FRCS, FACS, Consultant in Plastic Surgery to the Royal Air Force, died in London on April 11, shortly before his 60th birthday. A New Zealander, he was famous above all for his wartime work at East Grinstead, where at the Queen Victoria Plastic and Jaw Injury Centre he restored badly burned aircrew and helped them to get back to normal life. The benefits of McIndoe's work were recorded by Flt Lt Richard Hillary in his book *The Last Enemy* and by William Simpson, now chief public relations officer of BEA, in *The Way of Recovery*.

Sir Archibald was life president of the Guinea Pig Club, which he founded for those he had operated on at East Grinstead (and who never afterwards turned to him in vain for help and advice), and had since 1956 been president of the RAF Reserves Club. At the latter organization's last annual dinner, presided over by Sir Archibald (reported in *Flight* for December 4 last year), the then CAS, Marshal of the RAF Sir Dermot Boyle, paid tribute to his work in restoring RAF aircrew "not only surgically but psychologically."

HELICOPTER CAPABILITIES AND ECONOMICS

THE future of helicopters was reviewed for the layman by specialists at a recent symposium held at The Polytechnic, Regent Street, London. A good many engineering firms sent representatives; and the presence of inspectors from the Metropolitan Police, the Isle of Wight Police and the Lancashire Constabulary suggested the increasing appearance of the helicopter upon the everyday civil scene.

In general, the speakers showed no tendency to underrate the problems both of economics and of air traffic control. But the advice of John Speechley, assistant chief designer of Westland Aircraft, that it would be best for those with no experience to fill their needs by chartering was a good summary of the warnings contained in all the papers.

The Parliamentary Secretary to the Ministry of Aviation, Geoffrey Rippon, opened the symposium with the assurance that the Government had a close and continuing interest in helicopter development. Consideration would be given to helping others besides the air corporations and independents in developing their use.

R. G. Austin, the assistant chief designer (helicopters) at Bristol Aircraft, gave a detailed paper on the basic performance offered by the present generation. He was impressed with the simplicity afforded by small gas turbine engines and said that the way was now clear for a realistic private helicopter. In three years it should be possible to produce a two-man machine which would sell for £5,000 and operate for £4 an hour (not including paying the pilot). It could have a speed of 80-85 m.p.h. and a range of 150 miles.

D. M. Davies, senior project engineer of Fairey Aviation, saw a strong demand for an economical aircraft which could shorten journey times. Helicopters of the S-58 size, with an all-up weight of about 12,000lb, were neither large enough, fast enough nor cheap enough to operate. At a high fare-level, operators like New York Airways hoped to break-even on 19,000lb 25-seaters of the S-61 or Vertol 107 type. The next generation, which now seemed to be going ahead in the Westland Group in the shape of the Rotodyne, would make competitive fares possible.

To make civil operations possible, it would be necessary to write new ARB regulations. Vertical take-off and landing posed new radio and navigational problems and heliports had to be found. It is not surprising that the main interest at present was with the big airline companies, which could handle this sort of problem.

His view of the development of vertical take-off was away from the two extremes of jet lift and lift by long rotor blades. The use of downward facing jets was a "brute force method," inefficiently discharging a small mass of gas at high velocity. The large helicopter with the long rotor and low-speed downwash was also much less satisfactory than the ducted fan, which had been demonstrated in the Doak 16.

Mr Speechley and F. W. Free, of BEA, both reviewed operating costs. Mr Free thought that economics of about eightpence per passenger nautical mile would be possible for 25-seat helicopters. Mr Speechley thought these might be fitted economically into short-range, high-frequency operations around cities. When it came to 100-200 mile journeys, we would need the 40-50 seaters, which would have operating costs of 4-5 pence per passenger mile.

His estimate of the price of a ticket on a 40-seat helicopter operating between Liverpool and Dublin or Belfast at a 65 per cent load-factor was £5 16s 6d (plus profit) compared to £4 to Dublin for a first-class single cabin ticket and £6 to Belfast. These figures rested on the assumption that indirect operating costs would be 40 per cent of direct operating costs.

Cranfield's Flight-Test Symposium

ON Thursday and Friday, April 7-8, over 200 people attended a symposium on flight-test instrumentation at the College of Aeronautics, Cranfield. They included representatives from aircraft firms and instrument manufacturers having connections with this specialized branch of aeronautical engineering, and overseas delegates from Australia, USA, Holland and France.

Many delegates commented on the timely nature of the symposium; with new-generation aircraft such as the TSR.2, D.H.121 and Bristol 188, a radical change is taking place in the techniques associated with prototype flight-testing. A great deal of interest was shown in radio telemetry and magnetic-tape recording as being the only airborne data-acquisition systems which would provide the answer to the problem of the large number of quantities to be measured in these aircraft.

The meeting was sponsored by the Department of Flight at the college, and the papers were arranged to cover a wide range of subjects including transducers, recording techniques, data handling and analysis, and future flight-test requirements based on research being carried out in Ministry establishments. The full list of papers was printed in the April 8 issue of *Flight*.

The present trend in the number of measurements to be made was illustrated (see diagram) by T. Kerr of Aero Flight, RAE Bedford. Tracing events back to the early 1900s when flight testing was carried out by a sensing element known as "seat of the pilot's pants," he was able to show the tremendous increase since then in the number of measurements required.

There is certainly a limit to the amount a pilot can be asked to do in a modern aircraft. One way of helping him, and an argument that was put forward as a case for telemetry, was described in a paper by T. Heffernan of A & AEE, Boscombe Down. During the spinning trials of the Scimitar, he related, certain information was telemetered to the ground and another pilot familiar with the aircraft was able to re-orientate the pilot in the aircraft during the spin, if necessary, by using this information. The telemetered quantities were airspeed, altitude, rate of roll, rate of yaw, and aileron and rudder angles.

Although this seemed a convincing argument for the use of radio telemetry, some delegates were doubtful as to whether it would form the sole method of obtaining accurate flight data. It certainly performs a useful monitoring function, however, and W. L. Horwood and J. Walsh (Radio Department, RAE) indicated how this monitoring function could be improved to provide a complete data-acquisition system.

On the question of accuracy, however, D. M. Ridland (RAE, Bedford) surprised many delegates by showing the order of accuracy required to evaluate aircraft transfer functions. Typical values for the longitudinal case were:—

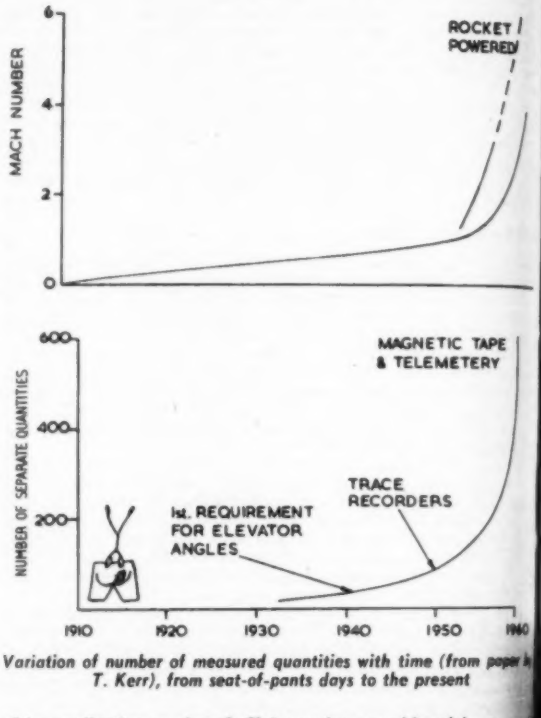
	Range	Resolution required
Elevator	4°	0.0067°
Incidence	2°	0.0033°
C.G. acceleration	1g	0.0017g
Rate of pitch	14°/sec	0.0233°/sec

Instrument designers and manufacturers must obviously strive for an order of accuracy higher than that currently accepted for flight testing. Mr Ridland thought that this could not be achieved with electronic aids and black boxes, which he seemed to distrust. This opinion caused a certain amount of argument, especially in view of remarks by D. A. Drew of Rolls-Royce that the flight-test engineer of the future must be a qualified electronics engineer.

Two instruments which are capable of the above order of resolution were described by W. R. Macdonald (RAE Farnborough) and W. Horath (SFIM, France). The force balance principle or, as it is sometimes called, the servo transducer, can give as an accelerometer a range coverage of ±0.01g to ±10g full-scale in one instrument with, according to Mr Macdonald, extremely high stability in its dynamic behaviour. These transducers have been used in the USA and also in Holland, according to T. Van Oosterom of NARI, Amsterdam, for in-flight thrust measurement.

M Horath gave details of the design and performance of a semi-floated rate gyroscope with an extremely good threshold performance and which incorporated a novel multipole inductive pick-off. One instrument nominally rated at ±20°/sec full-scale with a resolution of 0.001 per cent and a natural frequency of 30c/s had a linear range extending to 120°/sec.

The Instrumentation Department of RAE Farnborough was well represented at the symposium. Dr G. E. Bennett gave a review of the techniques of magnetic tape recording and the scope of its application to aircraft flight-testing, considered in terms of data capacity, data bandwidth and accuracy. He also showed a new tape deck designed by RAE to an SBAC specification, and demonstrated the miniaturization possible in the associated electronics. These modules were completely transistorized and formed part of a miniature tape-recording system for ballistic missiles.



Variation of number of measured quantities with time (from paper by T. Kerr), from seat-of-pants days to the present

The capacity of a magnetic tape system was shown by P. Bellerby of Blackburn Aircraft; in the case of the NA.39, he said, 10[illegible] quantities ranging from wing strains to airspeed and altitude were recorded on one machine.

Twenty exhibitors at the symposium, including Ministry establishments, showed items ranging from complete radio telemetry systems for aircraft to miniature differential pressure transducers just over one half-inch long. The highlight of the show was the first appearance in this country of the new all-solid-state airborne tape-recording system by Ampex (see photograph). At the [illegible] formal dinner which concluded the meeting, guest speaker F. W. Page (English Electric), chairman of the SBAC aircraft data-reduction committee, stressed the need for a closer liaison between design and flight-test departments.

The general feeling among delegates and organizers was that the symposium had proved a great success in bringing together flight-test engineers and the designers and manufacturers of instruments. In addition, Cranfield was able to show its own current work in the field of flight-test instrumentation. It seems probable that this symposium could become an annual or bi-annual event in the aeronautical calendar. Proceedings of the meeting may be published if there is sufficient demand, and enquiries should be addressed to M. A. Perry, Department of Flight, The College of Aeronautics, Cranfield, Bletchley, Bucks.

Airborne units of the Ampex AR200 all-solid-state magnetic tape-recording system, displayed at the Cranfield symposium

View from a satellite: a picture transmitted by Tiros 1 on its 43rd orbit of the Earth at a height of 450 miles, on April 4, showing (1) the Red Sea, (2) Gulf of Aqaba, (3) River Nile, and (4) Mediterranean Sea. Clouds cover Saudi Arabia (5)

Missiles and Spaceflight

SPUTNIK 3 DEAD—OFFICIAL

Confirmation that Sputnik 3 entered the dense layers of the atmosphere and "ceased to exist" on April 6 was given officially in Moscow on April 10. The satellite had been in orbit for 691 days and had covered a distance of over 278.5 million miles during this time. The last radio signals to be received in the Soviet Union were picked up during the 10,035th orbit, on the morning of April 6, and "according to calculations and the data of the last observations made in the western hemisphere, the sputnik ceased its existence on the 10,037th circuit when its orbiting time was about 87min."

Launched on May 15, 1958, Sputnik 3 had an initial apogee and perigee of 1,168 and 140 miles respectively, and an orbital period of 105.95min. On May 8, 1959, it completed its 5,000th orbit, at which time its apogee had been reduced to 792 miles and its orbital period to 99min. The final decelerative period as the sputnik entered the denser layers of the atmosphere began on March 27-28, and at the time of its 10,000th circuit, on April 4, apogee, perigee and orbital period were estimated as 143 miles, 103 miles and 88.6min.

The last visual observation of Sputnik 3 was reported from Finland on the 10,033rd orbit at 1.45 a.m. on April 6, when the satellite was in a roughly circular orbit at a height of 70 miles. In Britain, two final sightings were made at 4.24 a.m. on March 24 (circuit 9,825, height 170 miles) by R. D. Everest of the Radio Research Station, Slough, and H. E. Butler of the Royal Observatory, Edinburgh. As reported last week, Slough's final radio observation of the sputnik was made at 7.43 a.m. on April 6 during its 10,037th circuit—now stated by *Pravda* to have been the last.

TIROS 1 DETAILS

Speaking of the first week's results from the experimental meteorological satellite Tiros 1, NASA Administrator T. Keith Glennan said on April 8: "To date this meteorological experiment in space has performed exceedingly well. We have in fact been embarrassed by the wealth of photographic material which has been received." During this period the satellite had completed 101 circuits at an altitude of approximately 450 miles, and "hundreds of pictures" had been received by ground stations at the Research and Development Laboratory of the US Army Signal Corps at Fort Monmouth, New Jersey, and at the Kaena Point station in Hawaii operated by Lockheed for the Air Force (see heading picture on this page).

Giving details of the equipment and operation of the satellite, Dr Glennan continued:—

"The two Tiros TV cameras differ in coverage and resolution. The wide-angle camera, at 400 miles altitude, is designed to cover an area of cloud cover roughly 800 miles on a side. The narrow-angle camera will photograph a smaller area located within a wide-angle camera's view. The narrow-angle camera pictures cover 80 miles on a side.

"Identical except for lens equipment, the cameras are both the size of a water glass and use a 1in Vidicon tube especially designed for satellite use. Each camera consists of two parts: a Vidicon and a focal plane shutter which permits still pictures to be stored on the tube screen. An electron beam converts this stored picture into a TV-type electronic signal which can be transmitted to ground receivers.

"These are some of the characteristics of the cameras—lens speed (wide angle) f/1.5, (narrow angle) f/1.8; shutter speed 1.5 millisec; lines per frame 500; frames per second 0.5; video bandwidth 62.5kc/s.

Howard J. Childs of NASA's Electric-Propulsion Laboratory in Cleveland is here seen with the experimental ion engine referred to in these pages recently. It operates on liquid cesium from tungsten electrodes

Familiarization with the effects of weightlessness continues to be an important part of the training of the Project Mercury astronauts. Here five of the astronauts are seen during a zero-gravity manœuvre in a Convair C-131B operating from Holloman Air Force Base, New Mexico

"Connected to each camera is a magnetic tape recorder. Out of ground-station range, Tiros can record up to 32 photographs on the storage tape for later relay. Or, picture data from the cameras can bypass the tape and be transmitted directly to the ground when the satellite is within range of a station. The Mylar-base tape is 400ft long and moves 50in per second during recording and playback. The two TV systems and their associated equipment operate independently of one another.

"Photo data are transmitted from one camera at a time. Tape read-out from both cameras will take 3½min. The satellite will be within transmission range of ground stations up to 12min. This means that the satellite can transmit directly up to 4min of photo data collected while within range of the acquisition station. Connected to each photo system is a 2-watt FM transmitter operated at a nominal frequency of 235.00Mc/s which will relay picture information on command to ground stations. . . .

"One final point. NASA has repeatedly said that the Tiros 1 experiment is working successfully and well. That statement stands. However, since Saturday evening [April 2] the clock timer which commands

Missiles and Spaceflight . . .

the photo-storage tape-recorder for the narrow-angle camera has not been functioning properly. As a consequence, since then, the photographs taken by that camera have had to be limited to those taken upon direct command by either Fort Monmouth or Kaena Point and received directly (without going on to the tape recorder for storage) by either of those stations."

NAVIGATION SATELLITE

Transit 1B, first of a series of Earth satellites intended to provide the basis for an accurate navigation system for aircraft and ships, was successfully launched by means of a Thor-Able-Star rocket from Cape Canaveral on April 13. The prime contractor for Transit, a joint ARPA-Navy project, is Johns Hopkins Applied Physics Laboratory, Maryland.

The satellite payload weighs 265lb (this is the research and development version; the operational model will weigh only 50lb) and is a 36in sphere. Equipped with four radio transmitters powered by solar cells and chemical batteries, it attained a circular orbit at an altitude of approximately 500 miles. The batteries are expected to last for about five years, while the satellite may remain in orbit for 50 years.

The four objectives of the April 13 firing were reported to be (1) to check the navigation concept with simple demonstrations, (2) to obtain more knowledge of the ionospheric refraction of radio waves, (3) to improve navigational maps by studying the Earth's shape and gravitational attraction, and (4) to improve orbital tracking. The third stage of the launching vehicle was scheduled to be stopped and restarted in flight in order to achieve the required circular orbit.

DISCOVERER STAYS UP

Misfortune has continued in the USAF Discoverer satellite programme, with the unsuccessful attempt to recover the capsule of Discoverer 11 on April 16. Launched from Vandenberg AFB on April 15 by a Thor-Agena vehicle, the 300lb payload was said to contain "special new devices" designed to increase the probability of a successful recovery following ejection from orbit. Six of the previous ten Discoverer satellites have achieved orbit, but none has been recovered.

NO BLUE STREAK

The decision of the Cabinet not to proceed with Blue Streak as a military weapon (reported on page 552) inevitably has a widespread, and generally adverse, effect on this country's ability to conduct space research. It is appropriate to set out some of these repercussions, prefaced by a recapitulation of Blue Streak's characteristics. Officially described as a long-range ballistic missile, Blue Streak was intended to be our delivery system for thermonuclear warheads over ranges of the order of 3,000 miles. Prime contractor was de Havilland Propellers Ltd.

Features of the airborne system include: a very advanced airframe (D.H. Aircraft) fabricated in thin stainless-steel sheet, with internal pressurization and axial stiffeners over certain portions; propulsion (Rolls-Royce) by a twin-chamber powerplant running on liquid oxygen and kerosine, and having a sea-level thrust of approximately 300,000lb; and an inertial guidance system (Sperry) unofficially said to incorporate particularly advanced concepts. From the outset the missile has been designed for hard emplacement. Static testing of representative engines started at Westcott last year, and the complete tankage, gas generator, turbopump and propulsion system is now on test at the MoA establishment at Spadeadam. Flight trials were due to start during the coming summer from an *ad hoc* facility on the edge of Lake Hart, some 40 miles from the range-head at Woomera. All portions of the system have reached the hardware stage, with the exception of major items connected with the underground silos and its supporting systems.

It was on May 12, 1959, that the Prime Minister made the first official public utterance about a British space programme. In it he said "design studies are also being put in hand for the adaptation of the British military rockets which are now under development. . . ." At a Press conference the same day Lord Hailsham, then Lord President of the Council and now first holder of the post of Minister for Science, said that the project was purely civil, although obviously riding on the back of a military programme. Representatives of the MoS (now MoA) said that the most suitable vehicle would consist of a modified Blue Streak, a modified Black Knight and a solid-propellant third stage. The design studies on this were to be completed in six months (i.e., by mid-November), and the initial objective would be the establishment of a 1,000lb payload in orbit of "a few hundred miles."

In the event, the studies were not completed in November 1959, and at the beginning of February 1960 were reckoned to be completed "in perhaps a year's time" (from then). Moreover, all these studies have presupposed that Blue Streak hardware would be available. Cancellation of this missile will at the very least mean that a completely new set of cost figures will have to be prepared —figures far outside any budget which the embryonic Science Ministry has expected to need. Certainly the Government's Steering Group on Space Research has devoted little time to the feasibility of going ahead in the absence of a military LRBM programme; indeed, even the decision to do so on the back of such a programme had not been taken.

PIONEER 5 PROGRESS

The US solar satellite Pioneer 5 exceeded a distance of 3.5 million miles from the Earth on April 6, at which time the 60ft-diameter transmitting aerial at South Point, Hawaii, was beginning to have trouble in contacting the satellite. The 250ft dish at Jodrell Bank, transmitting commands to Explorer 5 at a power of 500 watts, was remaining in contact (the South Point transmitter, operating on 8,000 watts, needed to repeat its commands several times before the probe responded).

The National Aeronautics and Space Administration said that the Explorer was expected to continue transmitting by means of its five-watt transmitter for several weeks—"as long as payload performance and signal quality remain high"—and that an attempt would probably be made within the next 6-8 weeks to switch on the 150-watt transmitter. During its first month of flight, Pioneer 5 had telemetred an average of over two hours of data per day.

When the Hawaii station was forced to suspend operations for ground-transmitter repairs on April 5, battery temperatures in the satellite rose to about 100°F (20° above normal) because of overcharging, but did not reach the critical maximum temperature of 120° (when a charge-reducing circuit is designed to cut in and drain the overload). This temperature-rise indicated that the 4,800 solar cells in the probe's four paddles were working well and supplying some 16 watts to the chemical batteries.

Further details of the trajectory of Pioneer 5 were given by NASA as follows:—

"As of today [April 6] Pioneer 5 is gradually speeding up after falling off to a velocity low of about 5,360 m.p.h. relative to the Earth. As it speeds up, gradually it will start pulling ahead of the Earth on its orbital track between Earth and Venus. Based on abundant and highly accurate initial tracking data, the probe's speed is known to within 1.5ft/sec and its position to within 300 miles.

"A long-range projection of the Pioneer 5 trajectory shows that the probe and Earth will not come any closer than 16 million miles of each other before November 4, 1965. Meanwhile, the two will be farthest possible distance apart—183 million miles—in September 1962.

"Because of the eccentricity of the probe orbit, Earth and probe again will come within 15.6 million miles in April 1966. From then on this pattern will repeat itself every 5.8 years with the distances slightly different each time.

"A probe-Earth distance closer than the 1966 approach will not occur until 1989, when the two will come within two million miles of each other, according to present estimates. The probe-to-Venus distance will grow less until September 1961, when the two will be separated by 22 million miles. At that time, the probe will be 150 million miles from Earth.

"The probe and Venus will come within 15 million miles in November 1963. In February 1966 the probe will be roughly equidistant between Venus and Earth, about 20 million miles from Earth and 26 million miles from Venus. Greatest distance the probe will ever get from Venus is 160 million miles."

ATLAS BURNS, TITAN SHORT

Reuter issued two reports datelined *Cape Canaveral, April 8*. The first reads "An Atlas ICBM blew up on its launching pad here last night, sending out flames that illuminated the sea and beaches for miles around. When the countdown was completed —for a test of a new guidance system—flames suddenly engulfed the whole rocket. The fire raged for several minutes. It was the second consecutive test of the nation's only operational ICBM which ended with an explosion on launching."

The second states "A Titan ICBM launched today by the United States Air Force fell short of the target area because the second stage apparently burned-out too soon. An announcement said that everything went as planned until the second stage, which terminated early. Cause of the failure was not known. The Titan was due to travel 3,800 miles." It is, however, only fair to point out that it is only by achieving a fully instrumented failure that the performance and reliability of such weapons can reach proper levels. In early flight-testing a "perfect" mission is valueless.

SPACE IN THE SCHOOLS

A short course on space exploration, organized by the Ministry of Education at Bedford College, London, from April 9 to 15, was attended by some 50 teachers from secondary schools in England and Wales. Visits to University College and the London Planetarium were included in the programme, and among the lectures presented were *Propulsion Systems*, by A. V. Cleaver (Rolls-Royce; *Physical Conditions in the Upper Atmosphere*, by Dr P. J. Bowen of University College; *The Skylark Project*, by J. J. Gait (RAE); *Human Problems of Spaceflight*, by Sqn Ldr P. Howard (RAF Institute of Aviation Medicine); *The Black Knight Project*, by H. G. R. Robinson (RAE); and *Scientific Results from Space Research*, by D. G. King-Hele (RAE).

FLIGHT SYSTEM SURVEY

Where Are We Now?

THE decision of the ICAO Council to standardize DMET as a supplement to VOR was recorded in *Flight* last week. We stated then that Britain, France, Canada, Denmark, India, Australia and South Africa had voted against the standard, but after going to press we learned that the last four countries had in fact abstained. It was perhaps inevitable that the American proposal should be adopted but it is significant that it was only by extreme exertion and, their opponents claim, by intense economic and political pressure that the Americans were successful. Equally intense opposition from Decca has caused such bitterness on both sides that any compromise, such as the standardization of Dectra, is unlikely in future. Yet the Americans are still actively investigating Decca for helicopters—one of the many anomalies of the situation.

Successive ICAO discussions over past years make remarkable reading and it is worth noting that, even in the final Council meeting, delegates admitted that they were confused by intense bombardments of technical and other information and the ability or inability of VOR/DMET to fulfil the requirements was still a major issue a matter of minutes before the vote itself was taken. It seems clear that few nations can actually convince themselves that either VOR/DMET or Decca can really provide the navigation system which will be required for the critical air traffic control problems three years ahead. All they can hope is that DMET will form a useful prop in the chain of "building blocks" which the Americans claim will at some time in the future form the ultimate system.

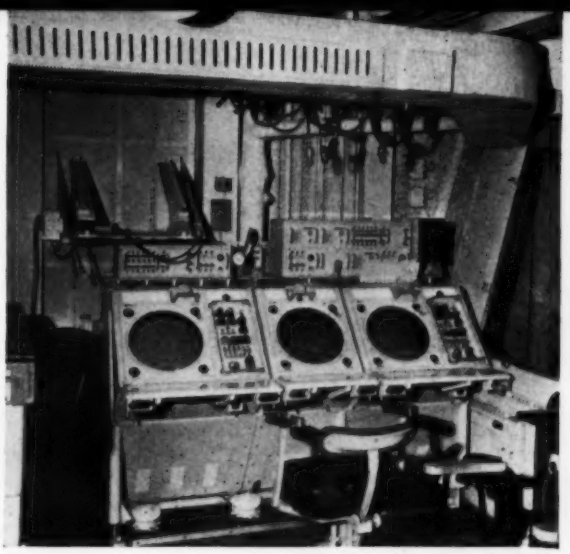
But now the standard has been fixed, and only the dissent of a majority of the 74 member nations, stated within six months, can reverse the decision. VOR/DMET is protected until 1975.

Britain has stoutly and unequivocally supported Decca and opposed DMET (but not VOR) during the past year and stated at the recent Eumed meeting that it would not implement DMET. Unless Britain climbs down, therefore, it must file a formal reservation and set up a DMET-less zone across some of the world's major air routes. How long can such a situation continue and what results might it have?

Continued support and use of Decca on British airways might be embarrassing and annoying but will allow Decca to bring into service the improvements which must absolutely establish its ascendency over VOR/DMET. Nevertheless it appears that only successfully maintained patent laws and the almost inevitable opposition of the powerful American business aircraft operators can prevent the Americans developing and internationally proposing a new hyperbolic aid if VOR/DMET proves dangerously inadequate, as Britain maintains it will.

For the immediate future in short range navigation we can foresee neither complete uniformity nor complete peace. The years to come may see air traffic in turmoil and in danger. It should not be forgotten that the ultimate stakes in this process are not national prestige or lucrative contracts but the tempers and the custom—and the very lives—of passengers. C. M. L.

Lord Douglas of Kirtleside, chairman of BEA, at the controls of a Tu-114 at Moscow. The instrumentation is described at right



The command staff position in the upper operations room of the carrier defence system using the type 984 radar in HMS "Hermes." The system was produced by Pye. Both hand and foot-operated controls are fitted to the consoles and an electronic "tote board" is used in the main plotting centre

Tu-114 Flight Instruments

THE picture on the left shows Lord Douglas of Kirtleside, chairman of BEA, seated at the controls of a Tu-114 in Russia. The principal instruments are visible in some detail and show the simplicity of the main panel with its black crackle finish. The centre panels, the edge of which can be seen on the right of the picture, span the stairway leading down into the navigator's compartment in the nose. They contain indicators and switches presumably related to engine operation, but no conventional throttle levers.

Sizeable welded ducting leads demisting air to all the cockpit windows and the panel immediately ahead of the pilot is additionally heated by a transparent electric element either applied to or imbedded in the glass and apparently provided with a thermostatic control. A windscreen wiper blade is visible on the left of this panel. The triangular window immediately aft can be pulled in and slid back for direct vision. Rubber-bladed ventilator fans are positioned near the pilots. The pale-coloured control wheel has a rotatable control concentrically mounted and probably serving nosewheel steering.

The instruments themselves appear well arranged in the pilot's line of sight beneath a high-set glare shield. From left to right, the top row includes an a.s.i. reading on a linear scale from 0 to 1,100km/hr, but having two needles overlapped in the picture. Next is a two-pointer altimeter on which the short needle indicates against an inner scale of thousands from 0 to 20,000m and the long needle against the outer scale from 0 to 1,000m. A window between the 400 and 600m marks shows barometric pressure in millimeters and the related setting knob is on the lower left edge of the dial. Third from left is a conventional ILS meter with blue and yellow sectors marked and to the right of it is a radio-magnetic indicator labelled as serving No 1 ADF. This dial has a rotating bearing card and lubber line at the 12 o'clock position. A needle, and "tramline" marker presumably associated with it, provide ADF bearing information and there are additional scales in degrees round the rim of the dial. A further black indicator reaches across the whole dial but has only a few single-degree lines at each end. It can be seen to be obscuring "06" and part of "24".

The lower row of dials includes, from left to right, a radio altimeter with two indication scales, an angle of attack indicator reading from +12° to −4° and a conventional electric artificial horizon with degrees of climb and dive marked on the skyplate. The height of the fixed aircraft silhouette is adjustable and an "off" warning flag is showing. Behind Lord Douglas' right hand is a large dial which very probably is another artificial horizon. It was noted earlier that the Il-18 has two horizons, one fully free in roll and the other of lesser freedom. One is standby to the other and operated by a separate supply. The v.s.i. is logarithmic and indicates in metres/sec, the maximum being 30m/sec (5,900ft/min). Next door is a plain ADF dial labelled as serving No 2 ADF. Below are a turn and slip indicator marked for banks up to 45° calibrated at 500km/hr; and to the right is a dial giving tailplane incidence angle from 0° to −4.5°. This one-way-only deflection was noted in our external description of the Tu-114 at Paris (*Flight* for August 21, last year). Outlined in white are two dials individually showing deflection of left and right flaps from 0° to 45°. Of the various warning lights on the panel, the one near the r.m.i. is the marker beacon indicator.

The final five Mirage III-A pre-production aircraft are superficially indistinguishable from the definitive III-C

MIRAGE

DASSAULT'S VERSATILE MACH 2 DELTA

by James Hay Stevens AFRAeS

THIS journal has frequently discussed the perennial concept of what may in general be termed the "light fighter." From time to time real midgets like the Blackburn Lincock, Ryan XP-77 and Folland Gnat have made their appearance, but in recent years new factors have tended to favour the evolution of relatively small combat aircraft. One of the most potent, of course, is the fundamental influence of money.

We have already, for example, described the manner in which Ed Heinemann evolved the A4D Skyhawk; and we have discussed "Kelly" Johnson's creation of the F-104 Starfighter to meet the shortcomings of aircraft which fought in Korea. While such machines were being planned in America, and while W. E. W. Petter was arguing the case for his newborn Gnat, the Générale Aéronautique Marcel Dassault began to turn their thoughts to the design of a small intercepter suited to operations in western Europe. While his factories churned out the streams of Mystères for the Armée de l'Air and for export, Marcel Dassault and his team set about the task of designing the smallest practicable all-weather intercepter which could reach 60,000ft in 6min while carrying collision-course missiles and a radar fire-control system.

During 1952 the French aircraft industry as a whole searched for the right formula for such a machine. After much experimentation the Air Ministry sponsored two families of ramjet aircraft and two families of rocket or mixed-power machines. The former were represented by the Leduc series and the Nord Griffon. The latter comprised the Sud-Ouest Trident and the Mirage I. The last-named was a small aeroplane of a purely experimental nature. Powered by twin Armstrong Siddeley Viper engines (a powerplant for which Dassault obtained a manufacturing licence), the MD.550 Mirage I flew on June 25, 1955. On December 17, 1956, it flew equipped with an SEPR.66 rocket. Like most aircraft rocket engines by SEPR, this unit is pump-fed and burns a mixture of nitric acid and Furaline. With the Mirage I Dassault convinced themselves of the correctness of the tailless delta configuration (and they also noted the excellent handling of the Fairey FD.2, and of its addition of 310 m.p.h. to the previous world speed record).

Armed with the data from the Mirage I, Dassault went ahead on a fighter, designated Mirage III. This aeroplane was considerably larger and more than twice as heavy, and from the outset made provision for combat equipment. Aerodynamically it retained a 5 per cent wing with a leading-edge sweep of 60 deg, but an entirely new fuselage profile resulted from the choice of a single turbojet, the engine being a SNECMA Atar 101G, rated at 9,900lb with afterburner. The first Mirage III flew on November 18, 1956, and eventually it exceeded M1.5 at about 36,000ft. Later it was fitted with an SEPR 66 for mixed-power development, and with this unit in operation reached M1.9, equivalent to approximately 1,255 m.p.h.

There followed a "pre-series" of nine development Mirage III-A aircraft. All are fitted with a SNECMA Atar 9, and have provision for an SEPR.841 fitted in a demountable pack. The thickness/chord ratio of the wing has been reduced to 3.5 per cent —thinnest in Europe, say Dassault—and the leading edge incorporates conical camber and an axial "notch fence." A variable double-shock intake is fitted, and the bulged nose radome has necessitated the addition of a ventral and larger dorsal fin. Each III-A has been allotted specific development tasks, such as guided weapons, handling, powerplant, electronics, and so forth. The first flew on May 12, 1958, and the following October 24 exceeded M2 in level flight at 41,000ft on the power of the Atar 9 alone. Another III-A established an international 100km closed-circuit record on June 9 last, at 1,785km/hr (963kt).

From the III-A has been evolved the production III-C, superficially identical to the fifth and later III-As. A total of 100 are to be bought in 1960, and the same number in 1961, 1962 and 1963. Deliveries are to start in September, and will be completed at a high rate. Dassault have also designed two additional variants, which have yet to be ordered. The III-B has a fuselage 19.7in longer in order to accommodate tandem seating for a crew of two. It can carry full combat equipment but is envisaged primarily as a dual-control trainer. The first was exhibited statically at the 1959 Salon and flew on October 21. The other offshoot is the III-D, in which additional internal tankage will confer a range of 1,240 miles and a revised nose will house special navigation equipment.

A recent opportunity to see something of the design and manufacture of the Mirage proved to be very rewarding. After the excellent impression created by this machine at the 1959 Salon, it was very interesting to see the structure beneath.

Aerodynamics

Simplicity must have been the watchword for the draughtsmen when laying out the Mirage. To one who was reared on old-fashioned streamlines, it is a joy to find a supersonic aeroplane that consists of something more than cones and cylinders. The basic wing is 3.5 per cent thick, with 60° 34min leading-edge sweep and 1.98 aspect ratio (probably close to the practical limit in the conventional reduction of wave drag). Since the leading-edge lies behind the Mach cone it has a fair radius. Even at the root, the trailing edge is sharp, suggesting that the low t/c ratio keeps separation within practical limits. Anhedral of 2° 30min counteracts Dutch roll.

Fin proportions are similar to the wing, save that the trailing edge is raked aft instead of forward. Like many other very fast aircraft, the Mirage has a small ventral fin, formed either by the rocket fairing or, when fuel is carried instead, by part of the supplementary tank.

Control surfaces are fully powered, and Dassault design and manufacture the electro-hydraulic units themselves. Port and starboard trailing edges are each divided into large-chord hinged sections. The small inboard surfaces are for trim only, and are actuated by jacks inside the fuselage. The elevators (central) and ailerons (outboard) are operated by jacks which protrude under the wing and are covered by deep triangular fairings. The tiny rudder has inset hinges and a rounded leading edge, and its power unit is mounted inside the fin and connected to a yaw-damper. The airbrakes are small plates above and below the wing roots near the leading edge mounted on arms which lift them clear of the surface. A drag-chute is stowed in a bullet fairing above the jetpipe.

Fuselage cross-section is based on a horizontal ellipse, within which area lie the air intakes, cockpit and canopy. The nose is shorter than is generally the case with supersonic bodies, but the blending from the point of the nose to the dorsal "deck" is very smooth. The canopy does not rise above the top line, and both the extent of the glazed area and the flat sighting panel are unexpected in an M2 aeroplane. The double-shock intakes are mounted about three inches proud of the fuselage to clear the boundary layer—which, instead of being dumped, is bled into the fuselage

Compared with the single-seater, the III-B two-seater is some 20in longer. The first example is here seen at Melun

and used for secondary cooling and tank pressurization. The semi-cone centrebody is automatically positioned axially to maintain optimum efficiency with the oblique shockwave focussed on the intake lip. One would imagine that intake efficiency is a major factor in the Mirage's high performance; in contrast, the superficially similar F-104 intake has a fixed geometry, and the only variation in airflow is effected by a controllable spill of excess air around the engine.

Despite the low-mounted wing, ingenious design has resulted in good open angles at its junction with the fuselage. There is a slight central protruberance, which allows the Mirage to stow away low-pressure tyres without bulges, while the fuselage walls meet the wing at right angles or a little better. The fuselage is slightly waisted in the region of maximum camber and is continued to the usual blunt tail which prevents flow-separation at high speeds. A quill fairing extends well aft of the trailing edge of the rudder.

Manufacture

The structural design of the Mirage is evidence of that deceptive simplicity which follows careful thought. The fuselage is of essentially conventional light alloy construction, although metal thicknesses are relatively high and some frames and longitudinal members are machined from die forgings. The wing is an adaptation of traditional ideas to a triangular planform, with sculptured skins and beams.

Fuselage manufacture and assembly is carried out at Argenteuil, near Paris. At the time of our visit, all nine III-As had been delivered, and the first components of the production run were on the sub-assembly jigs. The floor of the assembly hall was laid out with the tubular jigs, painted bright yellow to identify them with the Government contract of which they form part. Sub-assemblies start with panels or half-shells, which are joined port and starboard, some boxed by end-frames and others not. Then they are put into fixtures—elaborate gantries and trolleys that locate with grouted main locations—until the whole fuselage, apart from the extreme ends, has been assembled.

Fuselage frames are generally as deep as internal stowage requirements will permit, and they are notched to receive the continuous Z-section stringers. Most frames are built up as channels, or Z-sections, with sheet webs and extruded flanges. Many are deep enough to require flanged lightening holes; others carry loads that necessitate radial stiffeners and several are boxed with double webs. Fuselage sections are made in short lengths, either as complete halves, or as side, bottom and top panels, with the stringers and minor frame segments first riveted together and then skinned in the primary-assembly jigs.

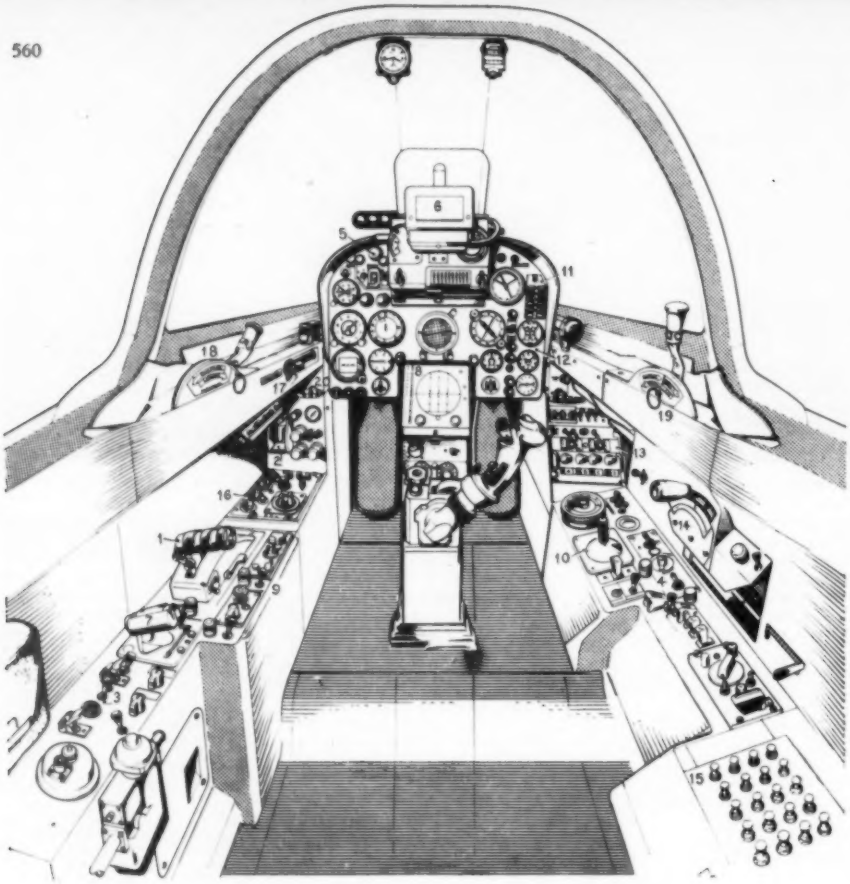
Most intricate of the fuselage components are the intake ducts and sliding semi-cones. Ram pressure at M2 can rise to five atmospheres, and the duct walls have to sustain this as well as the buffeting of high-velocity airflow. To obtain the necessary rigidity and strength, Z-section formers are riveted to the walls every 2 or 3in, without longitudinal members. The semi-cone is similarly robust, and is mounted on a pressure-tight sliding-plate assembly. Critical tolerances make the task harder, and this whole area is the most difficult of all to manufacture.

Two main frames are of particular interest. That to which the main spar is bolted consists of two deep (3in max) die forgings, each milled out on one side to give inner and outer flanges joined by radial webs. They are assembled back to back with a finger-plate round the periphery, recess-milled to take the adjacent skin. Just aft of the rear spar is another major frame, which forms the anchorage for the main fin spar. It is formed with two plate diaphragms, inside which are stretch-formed extruded channel sections which make the inner and outer flanges. Again there is a peripheral finger-plate (the stringers are riveted to the fingers) recessed for the skin. Along each side of the cockpit is an innocent looking L-section member, actually made by tricky three-dimensional copy-machining on a Cincinnati Hydrotel.

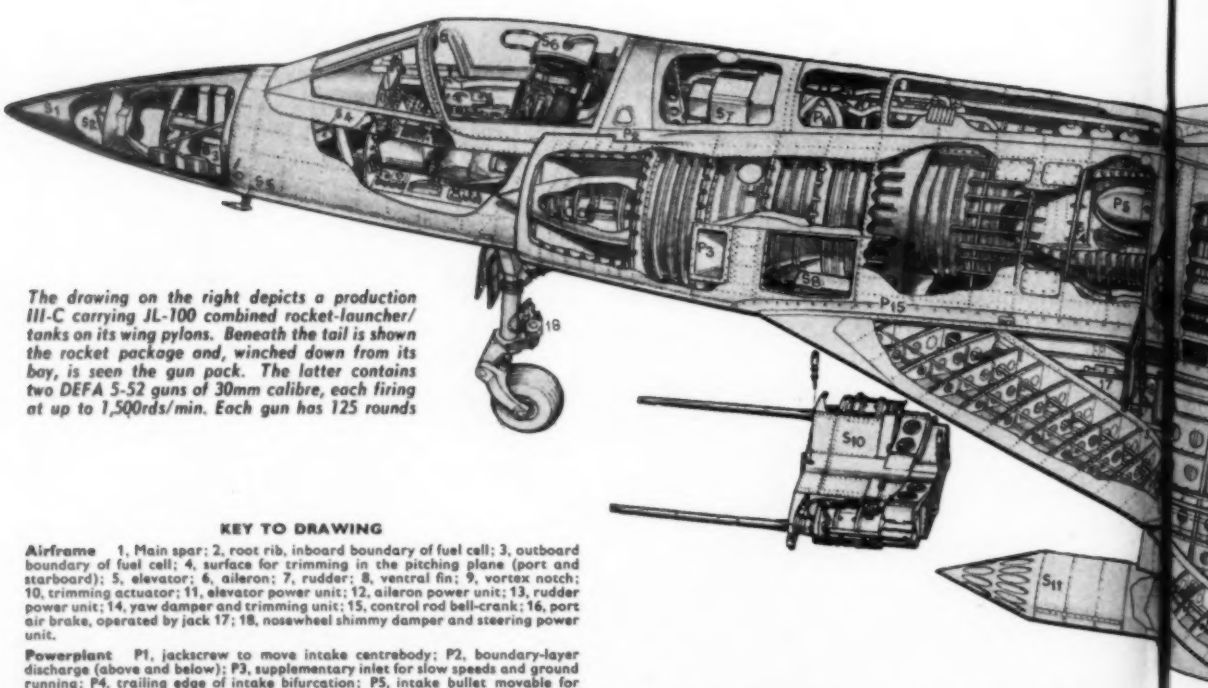
Delta geometry has led to an interesting wing structure. At about 40 per cent chord, normal to the centreline, there is a massive beam. It is a light-alloy forging, machined to an I-section with shear webs on front and rear faces, two root-attachment lugs, a boss for the undercarriage fulcrum and a smaller one for the passage of the elevator control rod. Diagonally from root to tip is a machined-channel spar, open side facing aft. Triangulation of the main wing framework is completed by the machined-channel spar to which the control surfaces are hinged, and machined front and rear root ribs joining the spars and the beams. The area

This lively picture shows one of the first pre-production Mirage III-As streaming its drag-chute after a flight with tandem 400kg bombs and wing-mounted tanks of 1,700 litres (375gal) each. It will be noted that the aircraft does not have the nose radome and accompanying dorsal fin

MIRAGE . . .



Some of the elegant simplicity of the Mirage cockpit is evident from the view on the left. Although an exceptionally small aeroplane its cockpit is roomy and the pilot sits in a Martin-Baker Mk 4 seat. Noteworthy instruments are the SFIM spherical-display horizon (invaluable for roll-out from an almost vertical climb) and the small standby horizon. Other items are: 1, power lever; 2, undercarriage, 3, engine starting; 4, weapon selection; 5, rocket control; 6, CSF Sadir sight; 7, radar control; 8, radar display; 9, trim panel; 10, command-guidance joystick for AA.20 or AS.30 missile; 11, centralized warning panel; 12, engine instruments; 13, radio compass; 14, air conditioning; 15, circuit breakers; 16, UHF; 17, canopy jettison, 18, drag-chute; 19, canopy up/down/lock control lever



The drawing on the right depicts a production III-C carrying JL-100 combined rocket-launcher/tanks on its wing pylons. Beneath the tail is shown the rocket package and, winched down from its bay, is seen the gun pack. The latter contains two DEFA 5-52 guns of 30mm calibre, each firing at up to 1,500rds/min. Each gun has 125 rounds

KEY TO DRAWING

Airframe 1, Main spar; 2, root rib, inboard boundary of fuel cell; 3, outboard boundary of fuel cell; 4, surface for trimming in the pitching plane (port and starboard); 5, elevator; 6, aileron; 7, rudder; 8, ventral fin; 9, vortex notch; 10, trimming actuator; 11, elevator power unit; 12, aileron power unit; 13, rudder power unit; 14, yaw damper and trimming unit; 15, control rod bell-crank; 16, port air brake, operated by jack 17; 18, nosewheel shimmy damper and steering power unit.

Powerplant P1, jackscrew to move intake centrebody; P2, boundary-layer discharge (above and below); P3, supplementary inlet for slow speeds and ground running; P4, trailing edge of intake bifurcation; P5, intake bullet movable for Mach numbers; P6, cooling-air intake; P7, accessory drive shaft; P8, engine-mounting trunnion; P9, rear-suspension swinging link; P10, nozzle upper eyelid; P11, main fuselage tanks, 2×55gal and 2×60.5gal; P12, rear fuselage tank, 83.6gal kerosine, replaceable by P18; P13, integral wing tanks, 2×117.7gal; P14, negative-g accumulator; P15, location of TX-11 Furaline tank (32gal), replacing S10; P16, rocket turbopump drive (93 h.p. at 5,070 r.p.m.); P17, turbopump group; P18, tank for 69gal nitric acid, replacing P12; P19, fixed rocket-motor chamber; P20, drain vent.

Systems S1, erosion-resistant radome; S2, stabilized search/lock-on scanner; S3, CSF Cyrano radar for navigation, contour and ground mapping, interception, weapon guidance (optional) and air/ground delivery; S4, radar presentation unit (see cockpit drawing); S5, pressure head; S6, Martin-Baker Mk AM.4 seat; S7, UHF radio and other electronics; S8, main electric equipment; S9, master reference gyro; S10, gun pack; S11, rocket pack (several types) with rear fuel tank; S12, braking-parachute container; S13, structurally isolated UHF aerial.

DASSAULT MIRAGE III-C

One SNECMA Atar 9C turbojet plus (optional) one SEPR 841 rocket pack. Data for these are given below.

Dimensions and weights Span, 27ft; length, 45ft 5in; height, 14ft 9in; wing area, 366 sq ft; t/c ratio, 3.5%; leading-edge sweep, 60° 34'; track, 10ft 10in; wheelbase, 15ft 9in; empty weight, 12,350lb; gross weight, normally from 17,600 to 22,860lb (see mission table); landing weight, 14,550lb.

Performance Take-off run, 2,000 to 2,800ft depending on mission; climb in intercepter role, 30,000ft in 3 min, 72,000ft in 9 min; operational ceiling, 82,000ft; economical cruise, M0.9 at 40,000ft; combat speed, M1.8; max speed at 36,000ft, M2.3; landing run, with drag chute, 2,000 to 2,800ft.

Powerplants Turbojet, sea-level thrust, 9,370lb dry or 14,100lb with afterburner; specific consumption, 1.0 dry or 2.075 with afterburner; dry weight, 2,755lb. Rocket, sea-level thrust either 1,650 or 3,370lb (no intermediate value); max thrust at 52,000ft, 3,700lb; specific consumption at full thrust, 0.0048lb/lb/sec at sea level, 0.00435 at 52,000ft; dry weight of complete pack, 450lb.

between the beam, spars and rear root rib is divided into 28 cells by pierced-and-flanged sheet-metal diaphragms, set normal to and parallel with the aircraft centreline, which preserve the aerofoil profile. Upper and lower skins of the torsion box are each made from two thick panels cut on Onsrud millers. The stiffening ribs lie normal to the centreline, and ridges (or bosses) support both the normal and parallel webs. The whole of this volume is an integral tank, except for the triangular tip cell and a dry-tunnel at mid-span respectively for part of the aileron and elevator jacks.

Ahead of the main beam the structure is cut out for the undercarriage, with a machined diagonal diaphragm carrying the front fulcrum for the leg and two fore-and-aft webs which support the air-brake hinges. Attached to the diagonal spar is the leading-edge, with close-set riblets braced by diaphragms, pairs inboard and single outboard. Push-pull control rods are mounted ahead of the diagonal spar; since the leading-edge is a fixture, access is by handholes.

Hinged trailing-edge sections are simple, with extruded-channel spars (open end facing forward) and closely spaced ribs. As the chord is considerable there is a second reinforcing spar. Elevators and ailerons are actuated at mid-span, and each has a boxed rib at that point incorporating a machined "bloater," the base of which extends between the spars and provides a large leverage for the power-unit jack. The inboard trim flaps have their spars reinforced by a torque tube, because the jack operates from inside the fuselage.

Although the fin is subjected to high aerodynamic loading in bending and torsion, it does not suffer the concentrated loads of the undercarriage nor the weakening effect of the cut-out. There are three spars of built-up I-section, with pierced-and-flanged interspar ribs and diaphragms. Aft of the rear spar is a shroud structure which shields the small rudder, which is similar in construction to the wing controls.

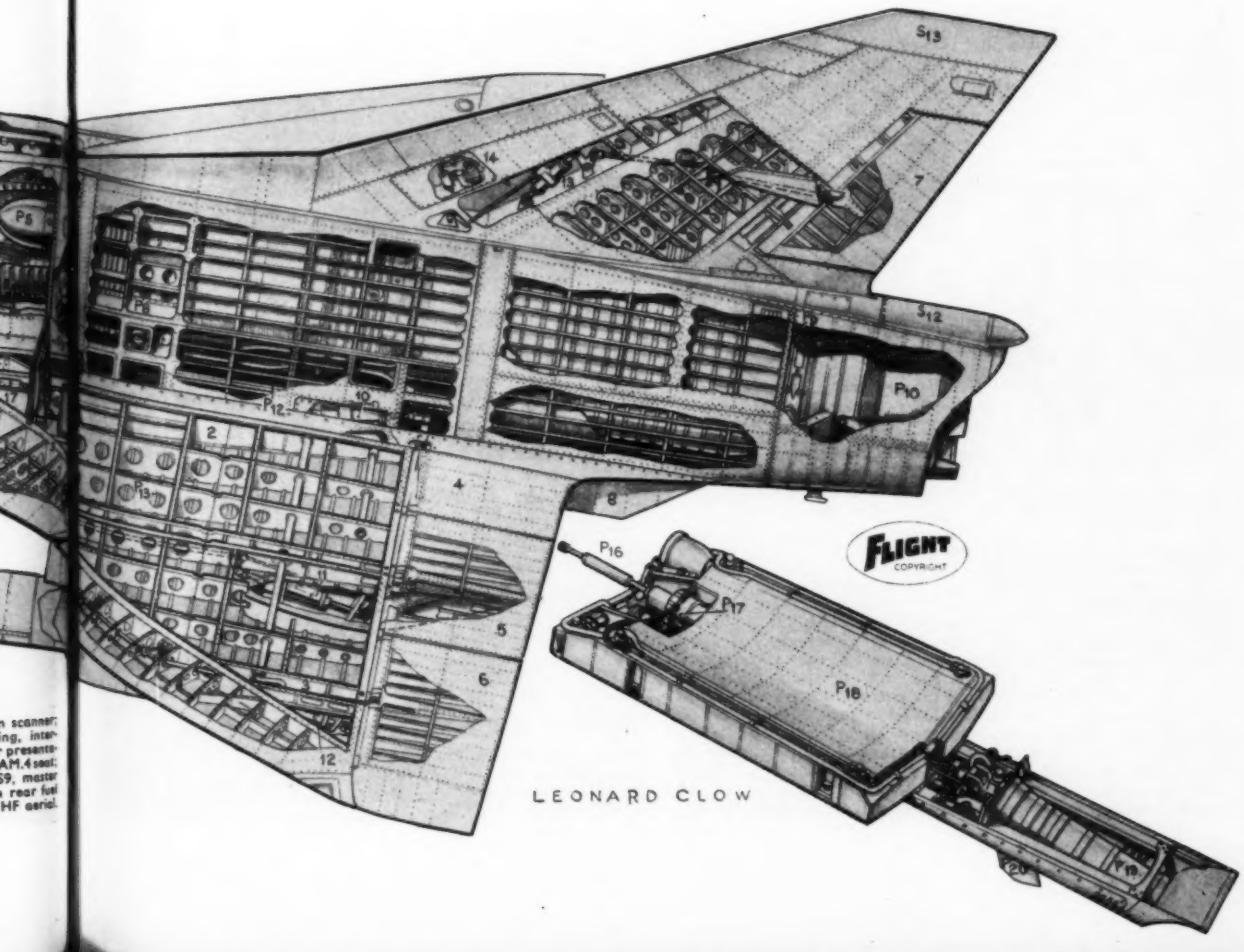
Aerofoil surfaces are manufactured by Nord-Aviation, although major machining tasks, such as the wing skins, root ribs and main beam, are done at Argenteuil. Finishing of the skin panels included shot-peening for stress relief. In addition to normal machining methods on large tools, Dassault has a chemical milling plant used for the rough-cut stage.

Since the ability to use 1,000yd PSP strips was part of the requirement, the Mirage is fitted with medium-pressure (75-115lb/sq in) tyres. The main legs are pulled inboard by jacks attached to the root rib. The nose-wheel is mounted on a trail arm and a shimmy damper is fitted to the steering head on the compression leg. All three wheels are carried on stub axles, so that they can be removed with only local jacking of the half fork.

The engine is installed on trunnions accessible through handholes. The Atar and its afterburner are assembled before installation. Only the cylindrical tail cowling needs to be taken off for engine removal, and there are ample handholes and panels for ordinary servicing. A refractory shield is fitted to the rear fuselage round the engine combustion zone, jet pipe and variable-area nozzle. As revealed at present, the Mirage has an Atar 9 with a clamshell propelling nozzle, but the Mirage IV bomber has a multi-leaf convergent/divergent supersonic nozzle, and there would appear to be space for the latter in the fighter—if the gain in efficiency on relatively brief flights is worth the weight. In addition to the wing tanks there are flexible cells round the intake duct which bring the normal internal capacity to 480gal.

Employed to boost combat performance, the rocket pack incorporates the turbopump—driven by quill-shaft from the accessory gearbox—tubular thrust framework and stainless-steel acid tank. The fixed reaction chamber projects down at about 10°. By undoing six bolts, the pack can be replaced by a 90gal fuel tank.

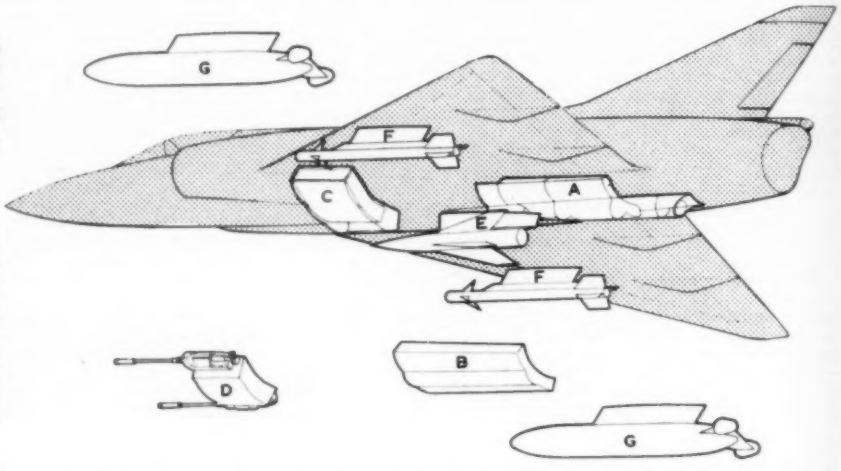
Accessibility and maintenance have been carefully studied. Radar is packaged in the nose. Radio, tank pressurization and some systems components lie between the intake ducts and are reached by removing the upper panels. Engine accessories and servicing points



MIRAGE III-C OPERATIONAL SPECTRUM

Role	High-altitude interception	Low/med-alt interception	Forward defence	Low-altitude penetration	Long-range strike	Ferry
Armament	AAM	AAM	AAM	2×30mm+30 rockets	2×30mm+tactical bomb	Internal armament
Gross weight (lb)	18,620	17,600	21,460	21,490	22,150	22,860
Rocket fitted	Yes	No	No	No	No	No
Fuel (Imp gal)	480 + 1,320lb acid	570	570 + 2×180	570 + 2×180	570 + 2×180	570 + 2×285
Flight plan	Climb at M0.9 to 30,000ft; accelerate to M1.55; light rocket; accelerate to M1.8 and climb to 60,000ft (6min 10sec total) and roll-out level. Interception radius 140 n.m., closing speed M2, manoeuvre speed M1.8. Subsonic return to base, plus two GCAs.	Climb at M0.9 to 36,000ft; accelerate to M1.8 and climb to 50,000ft (6min 40sec total) and roll-out level. Interception radius 150 n.m. Subsonic return to base, plus two GCAs.	Climb at M0.9 to 40,000ft; cruise at M0.9 for up to 550 n.m., including 2min combat. Total duration, 2hr 10min.	Penetration 250 n.m. all below 1,500ft, one-third 600kt, two-thirds 350kt; 10min search and attack; subsonic low-altitude return. Total duration 1hr 10min. Drop tanks can be 375 gal each, giving 350 n.m. radius.	Climb at M0.9 to 40,000ft; cruise at M0.9 for 550 n.m.; descend; 10min low-level attack; subsonic high-altitude return. Total duration 2hr 10min.	Climb at M0.9 to 40,000ft; cruise at M0.9 for 1,400 n.m. Duration 3hr. Alternative external fuel load is 1×180 + 2×375, giving 1,850 n.m.

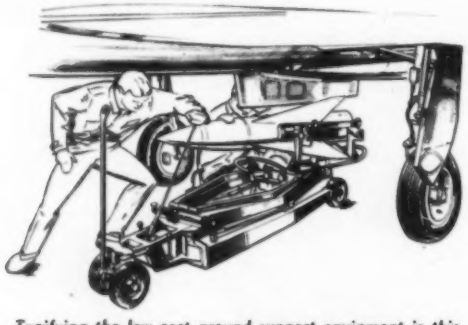
MIRAGE . . .



The various stores which the Mirage III can carry are represented by this diagram: A, rocket pack; B, alternative fuel tank; C, rocket-fuel tank, computer or gun-pack D; E, Nord AA.20 (5104) missile; F, Sidewinder missiles; G, 375gal tanks

are reached through an abundance of small panels and handholes. The accessory gearbox can be reached via ventral doors, and just ahead is the master reference gyro. A compartment in front of the mainwheel bays can be used to accommodate either packaged armaments or rocket fuel. Attachments under the fuselage and wing take pylons for missiles, rocket containers, or tanks.

To outline the operational philosophy of the Mirage design one may quote from a Dassault brochure. "The conflicting qualities of modern attack and defence have been met by a multi-purpose aircraft at the production level and a specialized one at the operational level: at the construction stage the number of different elements which characterize each version is very small, while at the operational level the aircraft is highly specialized by its propulsion system, equipment and armament." That is to say, the Mirage III is a basic M2 vehicle which can be rapidly converted from high-altitude intercepter to low-level attack—and most duties between.



Typifying the low-cost ground-support equipment is this neat trolley—shown in a Dassault drawing—for transporting and loading the Nord AA.20 missile. The AA.20 (or the Matra R.513) is always carried on the centreline

As an intercepter for the Armée de l'Air, the Mirage III-C will be equipped with CSF radar and computer, giving search and collision-course attack with AAM (one Matra on the centre line or two Sidewinders), and an SEPR 841 pack containing 1,320lb of acid. Five mechanics can convert the aircraft to the attack role in 30min, by fitting: a twin-30mm DEFA gun-pack with 200-250 rounds in place of the radar computer; a 90-gal tank in place of the rocket pack; bomb(s) on the central pylon and tanks or combination rocket/fuel tanks on the two underwing points. Take-off and landing run is always under 1,000yd, and the aircraft can use PSP strips. Zero-length launching has been studied in detail.

A comprehensive flight simulator has been designed and built for the Mirage III-C. This device is complete with sound effects and missile simulation, as well as AI radar presentation; a complete ground-controlled mission, culminating with a GCA landing, can be carried out in co-operation with an instructor.

Possibly the most interesting variant of the Mirage is the export version, currently being offered to Australia and other interested countries. This is quoted with a Rolls-Royce Avon Mk 210, rated at 11,800lb, or 16,800lb with afterburner—or 12,600lb at M2 at 36,000ft with 85 per cent intake efficiency. The Avon can be installed with only minor changes to the fuselage, and has the advantage of 20 per cent better specific consumption. For even higher performance, the RB.146 is being offered. Standard equipment would include Ferranti Airpass Mk 2 all-purpose radar.

HISTORIC BOMBERS

Famous Bombers of the Second World War, by William Green. Macdonald and Co (Publishers) Ltd, 16 Maddox Street, London, W1. Price 21s. Illustrated.

DURING the past decade many enthusiastic chroniclers, of whom Bill Green is one of the most renowned, have assiduously set down the histories of the aircraft which engaged in mortal combat between 1939 and 1945. In *Famous Fighters of the Second World War*, Mr Green was ably assisted by John Fricker, but this companion volume is entirely his own, the only major contributor being artist Gert Heumann.

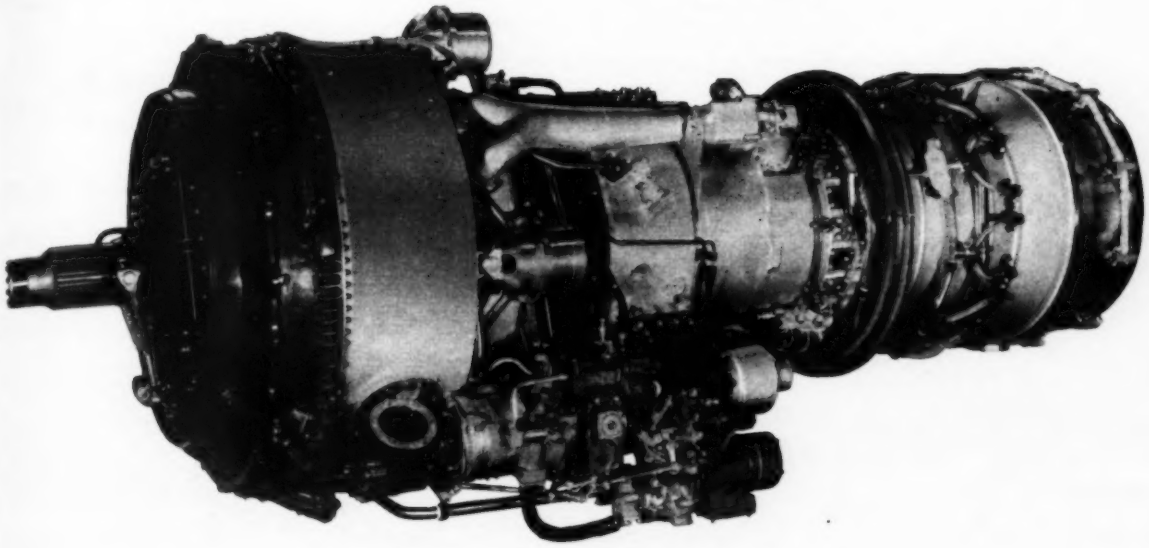
When one sets out to write a history of—for example—the Ju88, it would be fatally easy to become lost in a morass of triviality, and lose the thread of the story entirely. Mr Green is not averse to delving into the Ju88A-5/Trop and similar sub-sub-types, yet one can settle down and read any part of the narrative and sense the continuity which holds it all together. Moreover, the writer has always appreciated that a chronicler of great events and famous things does not need to dramatize them.

There can be few among our readers to whom the B-17, Wellington, Ju87 and Lancaster are mere aeroplanes. Many of us lived with them and fought with them—or against them—for years, and learned to love them or hate them according to their peculiarities. Now, 15 years later, it is strangely pleasant to recall that "in December 1942 Mosquito IVs of No 109 Squadron, flying from Wyton, had made use of the Oboe radar navigational aid for the first time," and to learn that "the Do217E-3/R4 had a PVC 1006B rack for a torpedo."

W. T. G.

TYNE

The World's Most Efficient Turboprop



NO company surpasses Rolls-Royce Ltd in building on solid foundations from the past. When one studies one of their engines it is fascinating to see the manner in which this application of hard-won experience maintains a thread of heredity, which makes the origin of the design unmistakable. Even the Tyne, the most advanced turboprop in the world and seemingly out on a limb of the ancestral tree, shows clear evidence of its origin, for throughout its design the proven features of Nene, Avon, Dart and Conway may be discerned.

Project designers at Derby began considering a successor to the Dart about 1953. This was the era of the "stretched Viscount" (*Flight*, December 9, 1955, page 861), and numerous schemes from 2,500 to 4,000 h.p. were considered. Eventually, Dart development toward 2,500 h.p., and the decision to limit the stretch of the Viscount and design a much larger successor, led to concentration upon a 4,000 s.h.p. design, the RB.109.

Detail design was started in May 1953. In order to get a low fuel consumption a high pressure ratio was necessary, and to obtain this while retaining good control-response, a two-spool compressor was chosen. Design labour was reduced by scaling the already tested compressor of a Conway. This was done not by making a direct "pantograph" copy, but by scaling down to give the required hub/tip ratio. On the other hand, the single-stage h-p. turbine and three-stage l-p. turbine were directly scaled, from the Conway and Dart respectively.

Three development RB.109s were put in hand before the design was advanced, by adding a zero-stage to the l-p. compressor and reducing the h-p. stages from ten to nine. This raised the mass flow and pressure ratio, and opened the way to development into the 6,000 s.h.p. range. An RB.109 first ran on April 23, 1955, and in October it passed the 25-hour type test for flight clearance. The full MoS/ARB 150-hour type test was carried out successfully in February 1956. So similar was the RB.109 to the Tyne that these first three engines were converted to RTy.1 standard, and are still used in development running.

As the programme was consolidated, following the ordering of the Vanguard by BEA and TCA, 15 development engines of the definitive Tyne configuration were built. The first ran on the bench in January 1956 and passed its 150hr type test in December of the same year.

The flight-test programme started in June 1956, with the Tyne-Lincoln, carrying the new turboprop in the nose as a fifth power unit. This aircraft has been a particularly valuable tool, because it was possible to fit an elaborate rig capable of simulating the full range of the rigorous ARB icing requirements, and it is still operational at Hucknall. In August 1958 a twin-Tyne Ambassador flew for the first time. On January 20, 1959, the first Vanguard flew, and the following month saw the first flight of an ex-BEA Elizabethan, used for endurance testing of Vanguard powerplants before the carriage of passengers. From March 6 to October 16 it was flown an average of 7hr 15min daily—by five crews, one R-R and four BEA—equivalent to an annual utilization of 2,650 hours. Four engines were used, but in order to get the maximum knowledge from this test the flying was concentrated upon two of them, the others being used simply as change units. As a result of this policy it was possible to get 1,500 and 1,350 hours on two engines. On November 15 came the first flight of a Canadair CL-44, and then on December 9 the ARB gave Normal Category Type Approval to the Tyne 506 (RTy.1) for the BEA Vanguards and the Mk 512 (RTy.11) for the TCA aeroplanes.

Two significant dates in 1960 have been the ARB Type Approval on February 26 of the Mk 515 (RTy.12) for the Canadair CL-44, and the certification of all three marks by the US Federal Aviation Agency on March 8. By the beginning of April the 18 development engines had accumulated over 12,000hr on the bench and, together with Vanguard and CL-44 production flying, almost 9,000hr in the air. Ground running involves endurance type-test runs (fifteen 150hr schedules have been completed) with flight propellers, and dynamometer benches for functional and component testing.

All four Tyne versions so far announced are of one basic type. Improved turbine-blade cooling (with increased nozzle throat area) distinguishes the later versions from the RTy.1. The RTy.11 and 12 are identical, and have the same turbine-inlet temperatures, the latter having a larger jetpipe which increases the pressure drop through the l-p. turbine to give increased s.h.p. at some loss in jet thrust. The greater power of the RTy.20 is attained by raising the turbine-inlet temperature. Development to 6,000-6,500 s.h.p. for take-off is possible with the present geometry, and higher powers could be obtained by component modifications.

Basic Design

Any turboprop in the class of the Tyne is basically laid out behind the optimum geometry of spinner and intake. The Rolls-Royce designers adhered to the logical annular intake, and—since it has to encompass a 6,000 h.p. gearbox—its diameter is large in relation to the high-efficiency compressor. It is still small, how-

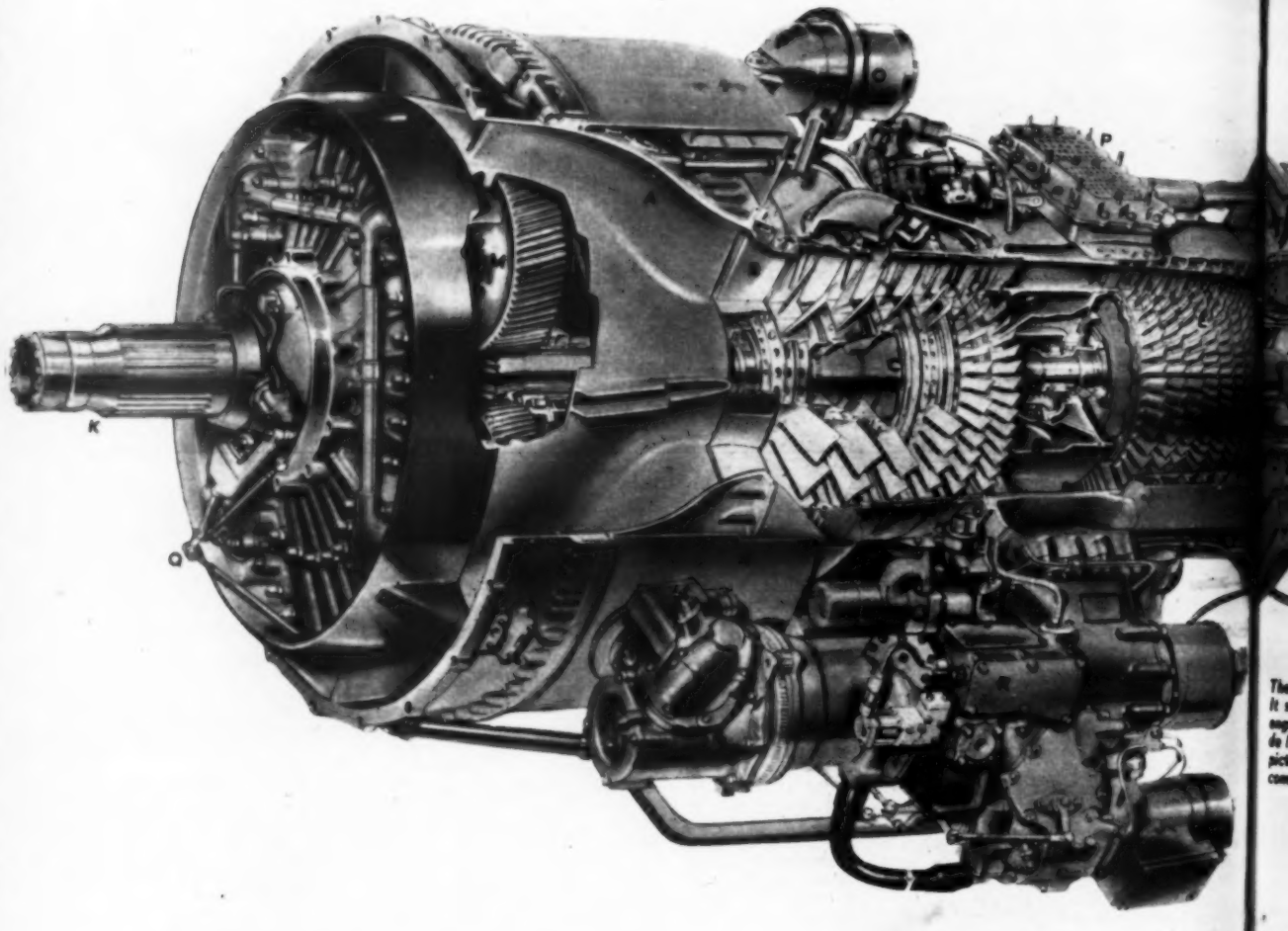
TYNE...

ever, in comparison with the nacelle lines needed to match the spinner taper and contain the necessary accessories.

The Tyne is a monocoque engine. Its stress-carrying body consists of the magnesium-alloy reduction-gear and intake casing, the steel rear shell of the cylindrical oil tank, the steel drum of the l-p. compressor, the aluminium-alloy intermediate casing, the stainless-steel outer casing of the h-p. compressor (which acts as a heat shield), the steel combustion-chamber outer casing, the steel nozzle box and turbine casings and the stainless-steel tail-cone assembly. Owing to the weight of the gears, the c.g. is near the front of the l-p. compressor, and so the dynamic mounting units are attached to the rear shell of the oil tank.

by ten struts. All bearings are cooled and pressurized by compressor bleed air, and protected by labyrinth seals. Great care has been taken to ensure individual filtering of oil supplies, and there are separate scavenge pumps for each main bearing.

Air entering the Tyne is diffused in the intake duct, passes through the "swan-neck" contraction and then through the fixed inlet guide vanes into the six-stage l-p. compressor. The i.g.v. and first stators are hollow, for bleed-air anticing, and are fabricated from Nimonic sheet, welded and brazed to cast inner and outer shroud plates, or platforms. The tapering cast-steel compressor drum is grooved for the tongued feet of the four remaining aluminium-alloy stators. The l-p. shaft comprises a short front section with the splined high-speed pinion and an integral disc for the first (zero) stage bolted to the main section, which has a helically splined extension for joining to the rear l-p. shaft.



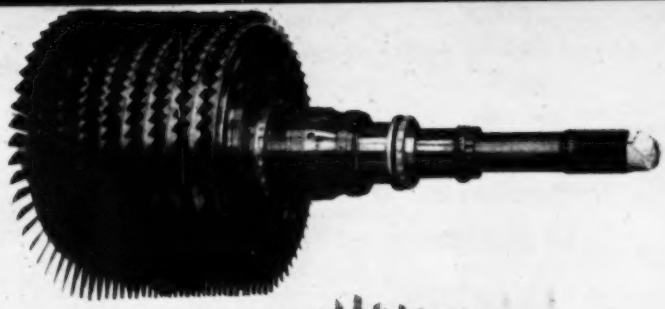
Six rotor bearings depend from the monocoque shell by strut systems that carry the loads across the ducts. Neglecting the reduction gear with its bearings, the forward support is the l-p. compressor front roller bearing, which is held by seven hollow struts in the "swan neck" inner wall of the intake casting. The l-p. rear roller bearing and h-p. roller front bearing are housed in the intermediate casing, by a system of internal webs and ten streamlined struts.

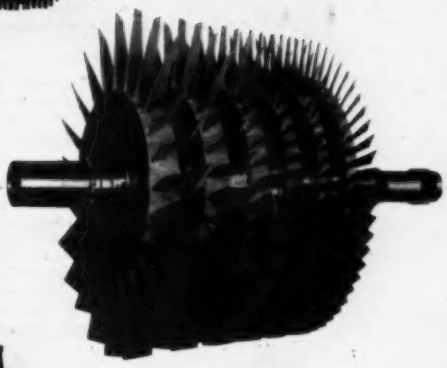
Supported by the delivery duct is a large ball race which acts as the h-p. rear bearing. It carries the thrust on the h-p. shaft, together with that on the l-p. system by way of the intershaft bearing. Originally a spherical plain bearing was tried here, as a means of providing for thrust loads, but it was replaced first by a double ball race and then by the present single ball race. Suspended from the outer casing through the nozzle assembly, the turbine front roller bearing is the rear support for the h-p. shaft. The tail bearing is on the end of the l-p. shaft, and is held

The aluminium-alloy blades are mounted in the steel discs by loose-fit pins locked by the steel interstage drums. Near the spline attachment, the discs have the characteristic R-R "hairpin" section, which maintains the spline interference fit while running.

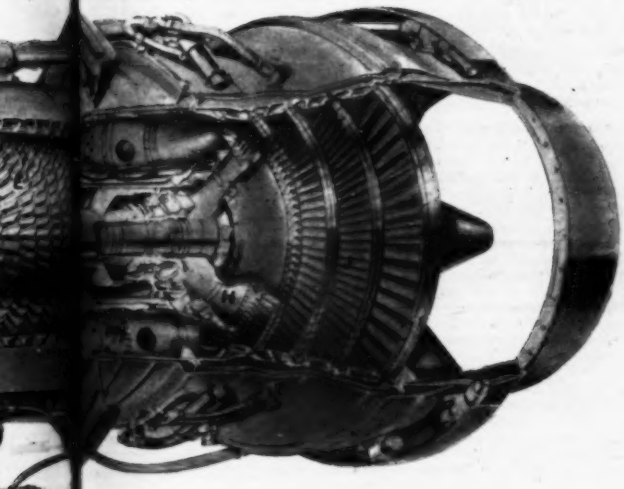
Of light alloy, the intermediate casing forms an inter-spool settling duct, divided into ten by the long-chord struts which carry the bearings. Entry and exit guide vanes straighten and pre-swirl the airflow. On top of this casing is a sliding gate valve for bleeding the l-p. delivery to atmosphere under flight-idling conditions. The casing also carries the wheelcases.

Centrifugally cast steel is used for the casing of the nine-stage h-p. compressor. Eight rows of steel stators and the outlet guide vanes are assembled by tongues-and-grooves in steel rings that, together, form an internal drum within the stress-carrying shell. External flanges on two of the rings, touching the shell, divide the space into manifolds, the centre one of which receives 7th-stage air through the cut-back outer platforms of the blades. Again



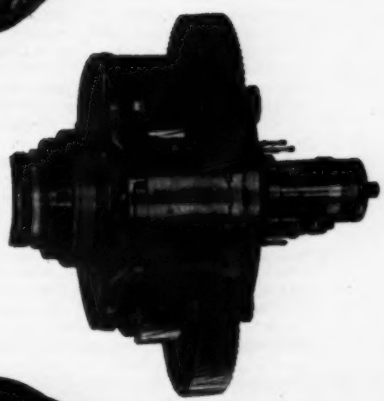


Perhaps the most critical single component of a gas turbine is its compressor. Above is the Tyne's nine-stage h-p. spool, and the six-stage l-p. compressor is pictured on the right



The large drawing above was prepared by a Rolls-Royce artist in Derby. It shows well the principal features of a standard production RTy.1 engine. All Tynes so far ordered will be equipped with propellers by de Havilland Propellers Ltd, although this important component is not pictorially evident in these pages. For the Rotodyne, of course, the complete basic turboprop will also drive at the rear, through a hydraulic clutch, to an auxiliary compressor

Housed within a casing of magnesium alloy, the reduction gear annulus is surrounded by 24 torquemeter dashpot cylinders. The operation of the torquemeter, and of the automatic drag-limiting system, is described on page 566



The drawing at the foot of page 566 clarifies the geometry of the epicyclic reduction gear. The three planetary gears (right) are carried in a neat and rigid spider attached to the rear of the propeller shaft

Towards the end of the opposite page it is pointed out that the h-p. compressor stators are carried in steel rings lying inside the stress-carrying outer shell. Both shell and rings are here evident

ROLLS-ROYCE TYNE

Configuration Two-spool turboprop with six-stage low-pressure compressor, nine-stage high-pressure compressor, ten combustion chambers in annular casing, single-stage high-pressure turbine and three-stage low-pressure turbine. External diameter over intake, 35.3in; overall installational envelope diameter, 40.5in; overall length, 110.15in; dry weight, 2,070 to 2,150lb, depending on mark.

Performance RB.109, sea-level static: mass flow, 41.4lb/sec; l-p. ratio 3.2; h-p. ratio, 3.77; overall ratio, 12.05; maximum power, 4,000 s.h.p. (4,430 e.h.p.) with s.f.c. of 0.535 (0.485). RB.109 at 30,000ft, cruising at 425 m.p.h.: mass flow, 14.9lb/sec; l-p. ratio, 2.38; h-p. ratio 4.68; overall ratio, 11.15; power, 1,880 s.h.p. (2,088 e.h.p.) with s.f.c. of 0.437 (0.393).

RTy.1 Mk 506, sea-level static: mass flow, 46.6lb/sec; l-p. ratio 3.35; h-p. ratio, 4.88; overall ratio, 13.67; maximum power, 4,500 s.h.p. (4,985 e.h.p.) with s.f.c. of 0.539 (0.487). RTy.1 Mk 506 at 30,000ft, cruising at 425 m.p.h.: mass flow, 16.8lb/sec; l-p. ratio 2.55; h-p. ratio, 4.87; overall ratio, 12.45; power, 2,095 s.h.p. (2,320 e.h.p.) with s.f.c. of 0.442 (0.399).

RTy.11 Mk 512: as above except maximum power, 5,050 s.h.p. (5,545 e.h.p.) with s.f.c. in the cruising condition of 0.396.

RTy.12 Mk 515: as above except maximum power, 5,300 s.h.p. (5,730 e.h.p.) with s.f.c. in the cruising condition of 0.394.

RTy.20: as above except maximum power, 5,665 s.h.p. (6,100 e.h.p.) with s.f.c. in the cruising condition of 0.391. In the sea-level static condition the s.f.c. is 0.472 (0.439 on an e.h.p. basis).

TYNE...

the rotor shaft has splined lands on which the steel discs are mounted. Seven of the stages have titanium blades, but the last two are of steel to suit the higher temperature.

A fabricated steel delivery duct guides the air into the cannular combustion chamber. An argument for the cannular system in civil use is the long life and repairability of flame tubes. The Lucas/R-R duple burners are individually removable from outside. A separate heat shield round the shafts contains the cooling air.

Details of the single-stage h-p. turbine are restricted because of the cooled blading, although the air which cools the nozzle guide vanes leaves via five holes on the concave side near the trailing edge. The three-stage l-p. turbine has shrouded blades with fir-tree platform roots. Its large variation in hub/tip ratio is indicative of the work extracted. All rotor blades are forged and machined from various grades of Nimonic, while the nozzle vanes are Nimonic investment-castings. Discs are ferritic, and the casing is of cast steel for the inner shell and fabricated steel for the heat shield. The tailcone is built up on ten radial struts attached to a decagonal casing forming a triangulated structure. Inside some of the struts are cooling-air and oil tubes.

Reduction gear design shows a clear relationship to that of the Dart. Complications in the Tyne stemmed from the need to keep the cruising helical tip-speed of the 14ft 6in D.H. propeller down to M0.85, while maintaining high r.p.m. at take-off. The propeller aspects of the problem have been fully discussed (*Flight*, April 25 and August 8, 1958). Compressor matching was chosen so that the l-p. system overspeeds at take-off, while cruising is done at the lowest r.p.m. consistent with component efficiency.

Gear ratio is 0.064. An epicyclic gear was chosen, with helical teeth, for uniform seating without tilt under load. The high-speed pinion is splined to the l-p. shaft and drives three planet wheels. Deflection is only 0.0015in on the length of the planet pinion at full torque—and this is complementary to that of the high-speed pinion. White-metal plain bearings, with white-metal thrust washers, are used for the layshafts, and the high-speed pinion is supported in a double ball race bolted to the propeller shaft. This last is carried in a ball thrust race and roller journal bearing. The three propeller oil lines are transferred by concentric sleeves on the high-speed pinion via the three spider arms of the carrier to their respective bores and ducts in the propeller shaft.

Torquemeter and negative-torque signalling are essential features of high-power engines, where sudden change from thrust to drag can be catastrophic. In the Tyne the annulus gear is attached to the reduction gear nose casing by 24 dashpot cylinders which provide a hydraulic balance to the positive torque applied to the annulus under normal running conditions. The torquemeter oil pump supplies them with oil through a master cylinder, and the pressure-drop gives the torque reading. In combination are the engine portions of the automatic drag-limiting system (ADLS) consisting of four cylinders, disposed axially round the nose casing, containing pistons connected by push-rods to the annulus gear. Movement of the latter thus moves the pistons, and negative torque reduces oil pressure in the ADLS. If the latter were to occur in flight the annulus gear would rotate until it tripped the ADLS lever connected to the feathering control. However, the Tyne system also has to deal with reverse pitch and flight-idle, where negative torque is present. This is catered for by a mechanical override linkage from the engine control lever, which resets a relief valve controlling the negative-torque pressure in the flight-idle and beta pitch ranges (defined by control lever position) to render the ADLS inoperative until a preset negative torque is exceeded.

Engine power control has been so lucidly described by Rolls-Royce that it is impossible to better their own text:—

"Engine power control is exercised by a single lever in the cockpit which operates the linkage on the engine by means of which fuel flow and l-p. r.p.m. are interconnected. The r.p.m. in the flight range is controlled by the propeller control unit in the usual way, and the fuel flow by the flow control unit which automatically corrects for forward speed and altitude. Basically, this is the system of control which has given such satisfactory service on the Dart.

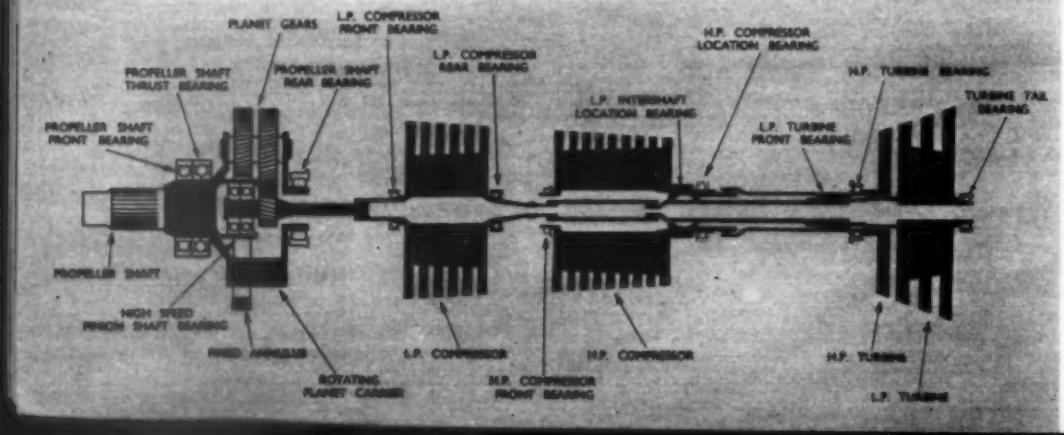
"Extensions of this linkage operate the negative-torque setting valve, the l-p. variable-datum governor [and, originally, the anti-icing valve] which are scheduled in accordance with the engine power setting. A further lever in the cockpit, known as the condition lever, operates another linkage on the engine by means of which the h-p. fuel cock can be operated, propeller feathering and unfeathering selected mechanically, and the proportional fuel trimmer linkage operated. The trimmer linkage provides a means whereby the fuel flow can be varied independently of r.p.m. over a limited range, in order to allow for variations in ambient temperature.

"Additions to the Dart system have been necessary in order to permit reverse-pitch braking to be used, and this has resulted in another throttle. This throttle controls the fuel flow in the beta range and provides at all times slightly more fuel than is required to keep the engine speed up to the l-p. variable datum governor. Both throttle valves are controlled by the power linkage on the engine.

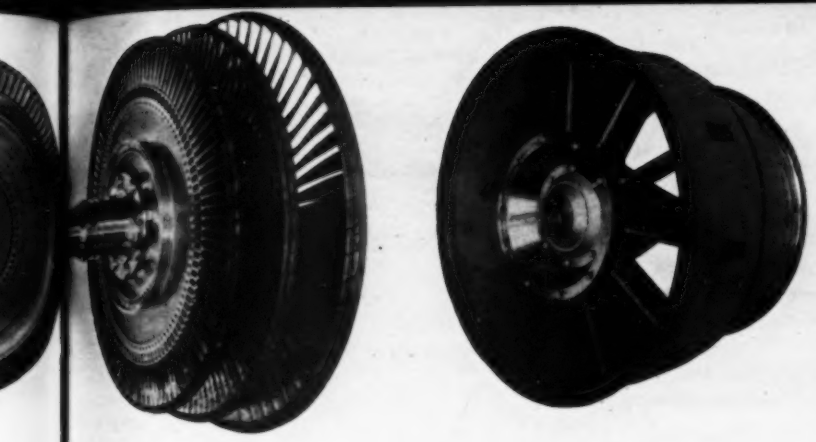
"Since fuel flow scheduled by the reverse throttle at ground-idle in the beta range is too high for starting, some means is necessary to reduce it to the required value. This is provided by a starting-flow throttle, operated by an electric actuator mounted on the flow control unit. This throttle has only two positions—open or closed. When closed for starting it cuts off the flow from the reverse throttle and leaves only the flow through the forward throttle by-pass. Interconnection of the starting throttle switch with the power lever makes it impossible to select starting flow, if the power lever is in any position other than ground-idle. An incidental advantage of this is that the engine can be idled at only 3,500 r.p.m., with consequent saving in fuel and reduction of noise if the aircraft has to wait on the ground with engines running.

"The term 'beta Range' may require a word of explanation. Beta is simply the symbol used for propeller blade angle; in this context it is synonymous with pitch. The system is of American origin and we have adopted the name as well as the system. Beta control of the propeller is used on the ground to give a smooth transition of thrust over the full range from flight-idling to full reverse both on landing and in taxying. In the beta range there is a propeller blade angle and an engine speed corresponding to every position of the pilot's throttle lever.

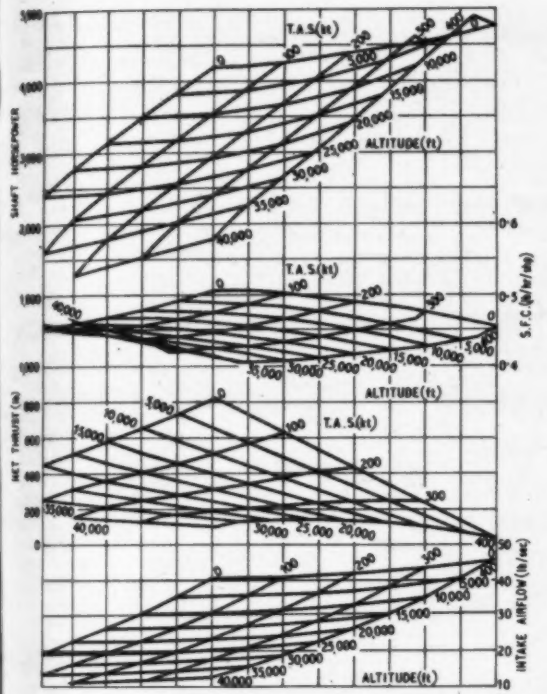
"The blade angle is achieved by using the propeller controller as a hydraulic position servo. On the nose casing of the reduction gear is



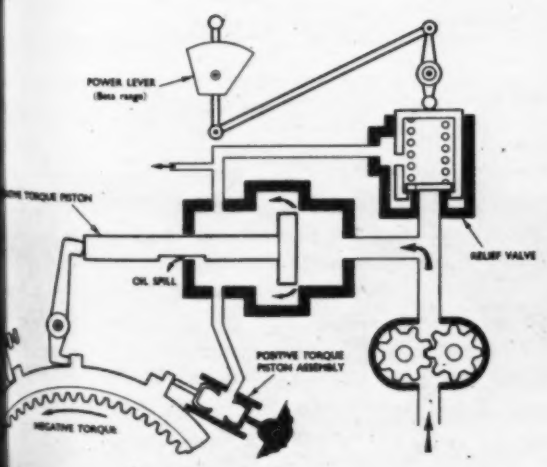
This diagram, which is not strictly to scale, clarifies the basic geometry of the main rotating assemblies. The low-pressure intershaft bearing is shown as a spherical pattern, in fact this is now a ball race, as explained on page 564



At far left is the delivery casing, divided into ten separate ducts by aerofoil spokes. Next comes one of the ten flame tubes—simple in the extreme, yet generating 2,700 gas horsepower. Then follows the h-p. turbine, so portrayed as not to reveal its air cooling, and the three-stage l-p. wheel, scaled from that of the RDa.7. The final picture shows the tailcone



Above are general performance curves for the RTy.12 at 13,500 cruising r.p.m. in ISA conditions. Below is a schematic diagram showing the relationship of major portions of the propeller control system in the flight-idle and beta condition. It supplements the text on these pages



mounted a yoke carrying two rollers which run on a thrust plate moved axially by cams on the propeller blade roots. This movement is transmitted to the controller by the yoke and the linkage attached to it, the whole being known as the beta feedback mechanism. Movement of the throttle in the beta range moves the governor valve in the controller, thus causing the pitch to change until the schedule pitch is reached, by which time the feedback mechanism has restored the valve to its governing position.

"The same movement of the throttle lever also selects the appropriate engine speed on the l-p. variable-datum governor which regulates fuel flow. This governor is an adaptation of the type fitted to all Rolls-Royce engines, where a pressure proportional to the square of the shaft speed is applied to the underside of the diaphragm. When this pressure exceeds the governor setting the diaphragm moves and operates the half-ball valve, which spills servo pressure and reduces the stroke of the fuel pump to maintain the set speed.

"To this governor has been added a cam and lever mechanism to enable the spring load to be varied in accordance with the throttle position. A balance spring on this mechanism takes most of the governor spring load and reduces the load on the throttle linkage. In the flight range of throttle movement the governor is set to approximately 16,700 l-p. r.p.m., but on pulling the throttle back into the beta range on touch-down the governor is reset to 10,500 r.p.m. in the first 5° of throttle-lever movement.

"Further rearward movement of the throttle selects the speed characteristic needed, which gradually increases to 11,000 r.p.m. at ground-idle, corresponding to a blade pitch of aerodynamic zero, and then rapidly increases to 12,800 r.p.m. at full reverse. For normal ground handling, sufficient thrust is available in the beta range, but if any higher forward thrust is required the throttle can be advanced into the flight range."

One could continue describing the Tyne almost indefinitely, but the foregoing are the major points for discussion. One feature, though, lacks reason without some explanation: the engine mounting system. The four "pots" belong to the engine and have to be matched by the airframe designer. Each contains a bonded-rubber bush which gives very stiff radial and flexible longitudinal support, a combination designed to damp out the first-order propeller vibrations. It also means there is considerable movement at the tail (almost an inch is allowed). This has been catered for in the Vanguard by a sliding carbon seal, and in the CL-44 by a piston-ring type of sliding diaphragm in the bulkhead.

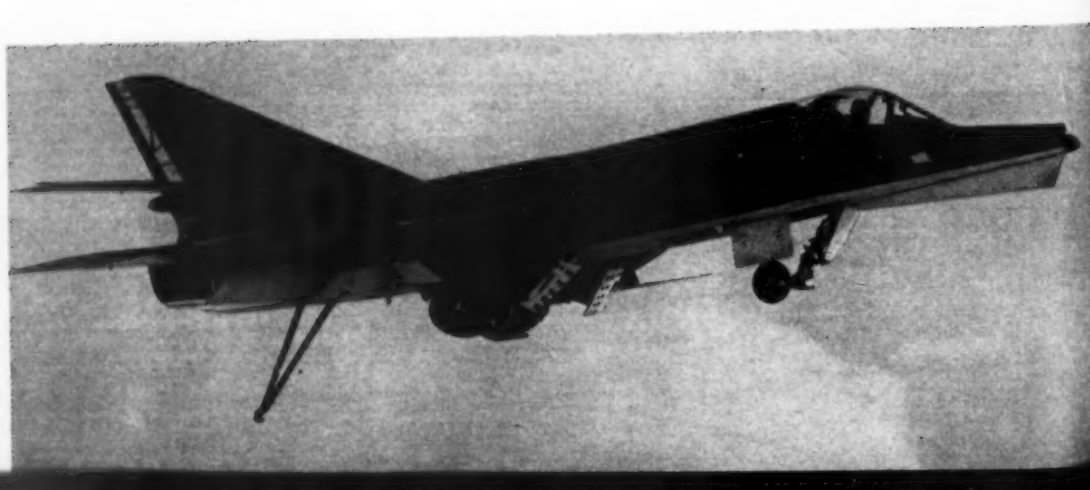
Prospects

To talk with Rolls-Royce sales staff is to breathe the air of confidence that the turboprop has a very big future. In fact, the very men who are selling by-pass turbojets to the airlines are convinced that the operational flexibility, capacity and economy which the turboprop confers will always have a place. Only as speed rises beyond 450 m.p.h. does the complication of the propeller itself become too great. While it is evident that Rolls-Royce is setting little store by any possible re-engining programmes, it is felt that the airlines, with unsellable surplus equipment for the first time, could build up the freight market into a really serious business. Out of the intensive use of old aeroplanes there will arise, in two or three years, the need for specialized, modern freighters. It is here that the characteristic conservative R-R engineering policy, coupled with dogged persistence, should bring reward. Since the Allison T61 has been put on ice, the Tyne is the only big turboprop with stretch capacity in the Western world.

Entry of the Tyne into service has exactly matched the R-R view of life: a nice steady progress, with a fair lead-time between invention and production. Vanguards will have been flying 18 months when they enter service with BEA in June, to be followed shortly by TCA's Vanguards and the production CL-44. Beyond this come the Bréguet 1150 Atlantic ASW aircraft for NATO, the Short Britannic and the Transall C-160 transport and the Rotodyne. As an accessory supplier, the best aero-engine company is in no position to dictate aircraft design policy; it can simply offer its goods and make suggestions. Nevertheless, Rolls-Royce seem confident that once the Vanguard enters service its superb qualities as a money-earning vehicle will build up the sales pressure for economical transport. And anybody who wants a big propeller-engine will find the Tyne virtually without a competitor. J.H.S.

SEA LEGS OVER BRITAIN

THE pictures above and below were taken by "Flight" photographer Ian Macdonald from our Gemini as the Avon-powered Dassault Etendard IVB flew in formation at about 113kt at 6,000ft. The French pilot was M Saget, seen at right in typically jovial mood. With absolutely everything—flaps, leading edges, air-brakes, arrester hook and undercarriage—down and out and blowing switched on, Saget was able to maintain formation for 20 minutes. Below he is just raising the undercarriage. The slab tailplane has the trimming tab raised for low-speed control. Beneath the nose is the new additional fin for low-speed stability; it also houses the aerial for the Nord missile-guidance radio. (Details, p. 552). The flying views are untouched and were taken with the same camera.



Straight and Level

WHEN I read that the Tu-114, the world's biggest airliner, had established a world's 1,000km closed circuit record at a speed of 544 m.p.h., and that it had done so *with a load of 25 tons*, you could have knocked me down with a feathering counter-rotating propeller.

Do you remember all those assertions, by propeller experts of unimpeachable technical competence, that 450 m.p.h.-500 m.p.h. is the limit for the transport propeller? And that counter-rotating transport propellers are not practicable?

● It looks as though Blue Streak is not going to be the deterrent that we thought it was going to be. To cut our losses, which may amount to hundreds of millions of pounds, we may therefore use it as a satellite launcher, for a space programme that—less than a year ago—was considered reasonable if done "on the back of Blue Streak."

What can we do except shrug our shoulders at this prodigious waste of money? Do we just say: "Oh well, no one could have foreseen that a fixed deterrent wouldn't deter?"

All right—*I* didn't foresee it. But I wish I had known when the Blue Streak programme was launched in 1956 that even then the importance of deterrent *mobility* was known—that the Americans were already thinking of an ALBM (which will now mature as Sky Bolt), and that they had actually started building Polaris and a fleet of nuclear submarines. If I had known that I would have suggested that Blue Streak should have been an ALBM. As it is, I'm just being wise after the event. But who in the Defence Ministry ought to have known?

● It is no good telling the public that jets are no noisier than piston-engined aircraft. They know from their own ears that it just isn't so. The Minister has said in Parliament that 90 db is less than is recorded by some piston airliners. This may be true, though I can't think why his experts' decibel readings were "processed in the laboratory." You just read them off a gauge, surely. It may be true, BUT—as I asked in this column over two years ago (February 21, 1958)—"would it be too cynical to ask his acoustics engineers not only to measure the noise, but also to *listen* to it?"

Are the public being blinded by science as well as being deafened by noise?

Most reasonable people agree to the need for a measure of *noise* and not just a measure of sound pressure. About eight months ago (August 28, 1959) I supported the use of the noy, N, as a more sensible measure of noise. You see, if you convert 90db into Ns (having first converted into PNdb) you will find that the jet reads 60N and the piston airliner 37N. In other words, jets are 60 per cent noisier than pistons—on the Minister's own figures.

But let's have another look at that 90db, for all its technical humbug. It happens that 90db is also the sound pressure measured by the New York authorities of jets and pistons *over 3,000ft high.* At 1,000ft (i.e., height-over-houses) their decibel gauges register 107 for jets and 104 for pistons—equivalent respectively to 274N and 104N. In other words, over New Yorkers' houses, jets are more than twice as noisy as pistons. Why is it different around London Airport?

Unlike the Port of New York, the Ministry has so far declined to publish any details either of noise tests or of noise-monitoring. *Flight* has asked for them, but they have not yet been given. So the public continue to think that they are being hoodwinked. This makes them twice as angry as they would be if they felt that the Minister, for all his dressing-gown diplomacy, was being candid with them. It won't be in the interests of aviation if the public swarms in thousands all over London's runways, in a "direct action" campaign which some agitators are now threatening to organize.

How about better public relations—i.e., publication of the results of tests and of monitored take-offs? And how about the substitution of noys for those deceitful decibels? The Minister should remember that the public has the best noise-measuring devices known to man.

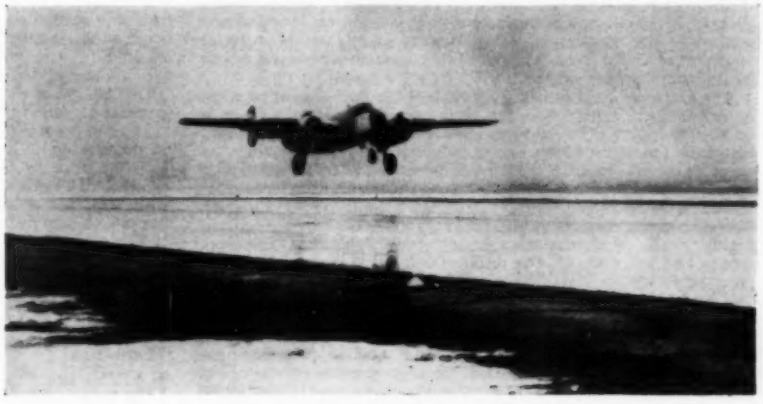
● A *Flight* colleague at his RAFVR medical recently was asked to say 111 (one-one-one) instead of the more familiar 99 (ninety-nine). Is this a subtle propaganda stunt by the Treble One glamour boys of Fighter Command to keep in the limelight all the year round? It's not as if they are just snuffing out an historic Bomber Command unit; 99 Squadron is now in Transport Command, which *everybody* loves these days.

● Suddenly, the stale atmosphere of "independents *v.* corporations" is freshly conditioned. A new concept of mixed-economy partnership is introduced, of State corporations and private enterprise working together (empty words no more) for the advancement of British air transport as a whole. The old boring bickering and belly-aching may be things of the past, even though the new cabotage operations (economy as well as coach) will be on a predetermined-capacity, pooled-revenue basis—about which more information is needed.

● Czechoslovak Airlines are very much an OK airline. Their service is OK, their aircraft are registered OK, and their service-prefix in the *ABC World Airways Guide* is OK. What more natural a promotional asset could an airline want? CSA make good use of it in their publicity.

But I don't know what to make of a footnote to one of their recent Tu-104A advertisements. "The Tu-104A," it claims, "touched 700 m.p.h. on a recent scheduled flight." Come on, out with it, chaps—what was the headwind?

ROGER BACON



In *The Fighting Temeraire* Turner rendered with unforgettable pathos the solemn progress of a mighty warship on its last voyage—to the breaker's yard. My picture this week is not by Turner: it is by a news agency photographer at Joe Foss Field, Sioux Falls, South Dakota. But it records an event that will sadden more hearts than ever grieved over the *Temeraire*. For this drab, lonely aeroplane, departing from a rain-drenched runway and heading into the mist is the USAF's last Mitchell on its last flight—and the Mitchell is numbered among the greatest of all bombers. Production exceeded 9,800. I am glad to learn that a good home has been found for this specimen at the Air Force Museum.

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Helping the Private Pilot

CONGRATULATIONS on your excellent Sport and Business Flying Number. I am sure it was appreciated by many of your readers, themselves "practical aviators," who are surfeited with details of manned and unmanned missiles!

There is one point I would like to add to your proposals regarding a modified UK *Air Pilot*. In the US, radio information is printed on the topographical maps in colour codes, and with all NDB and VOR identification both in Morse code and letters. This gives a visual representation of station identification and should help to prevent pilots selecting the wrong beacon. MF bands, as you know, are crowded with NDBs of varying power, and well laced with static. Even the VOR stations now in Southern England seem to have only a few megacycles' spacing.

Finally, the matter of representation. In the light flying world it seems a pity that we have two organizations that do not always see eye to eye. In gliding, one organization, the British Gliding Association, deals successfully with the Ministry of Aviation, issues its own Cs of A, and organizes all aspects of flying and instruction. Can the light aeroplane movement not benefit from this example, and not be legislated out of the story?

Farnham, Surrey — H. C. MACKINNON (Fox Easy Flying Group, Lasham)

Trek Airways

THE article headed "International Independent" in the April 1 issue of *Flight* was of considerable interest to me, particularly because of the mention of Trek Airways in relation to material diversion of traffic from SAA and other operators between South Africa and Europe.

The Overseas Aviation spokesman and the author of the article appear to have overlooked the fact that Trek Airways *holds a licence* to operate its services, granted by the South African National Transport Commission, which considers objections by other operators to all applications for licences. The particular licence which Trek holds stipulates: (a) the type of aircraft permitted to be operated; (b) the number of seats to be fitted to each aircraft and the maximum number of passengers to be carried per flight; (c) the maximum number of round flights to Europe per month and per year; (d) the minimum and maximum fares to be charged.

The Luxembourg authorities have also granted Trek traffic rights for scheduled services between South Africa and Luxembourg, and traffic rights for certain flights are also held in Germany (Dusseldorf), Switzerland (Zurich), and Austria (Vienna).

Permission to operate into UK is only granted for complete charters, and as a point of interest, traffic originating in, or bound for, the UK is relatively small compared with traffic derived from other sources, due mainly to this restriction.

If I have interpreted the provisions of the new Civil Aviation Licensing Act correctly, presumably Overseas TAAC will also require licences to operate either from Southend *or* Luxembourg, whether "closed group" or not, and this, to my mind, is only fair. No reasonable person can have any objection to duly licensed and controlled operation.

London WC2 — TREK AIRWAYS (PTY) LTD, W. E. Hamilton

"Eleven Died in Vain"

HAVING been a subscriber to *Flight* since 1941, I am pleased to inform you that the "Middle East Mystery" mentioned in Peter G. Masefield's letter published on February 26 is no mystery to me.

Readers who have copies of *Tee Emm*, circa 1943, will find the story outlined under the same heading as this letter.

The Blenheim Mk IVF depicted was one of eight issued to No 15 Squadron, SAAF, on its arrival in the Middle East in February 1942. These aircraft were unusual in having a 20mm (long) Hispano cannon mounted alongside the pilot on the floor on the starboard side and protruding through the appropriate bomb-aiming panel in the nose—this accounts for the panel being missing in the one photograph, as we removed the cannon late in 1942.

When 15 Sqn arrived in the Middle East it was purported to be the largest *mobile* air force squadron in the world, having some 700 personnel. At the time of the "mystery" the squadron was based at El Ballah on the Suez Canal, and its function was convoy escort to and from Alexandria; it was therefore attached to the Royal Navy. The squadron had commenced refitting with Blenheim Vs round about July 1942 and at this time a detached flight of Mk IVFs were sent to Kufra for general patrol duties and liaison with the LRDG.

On the fateful day the officer commanding the detached flight at Kufra decided to make a survey of the patrol areas around Kufra with two other aircraft. Each crew consisted of pilot, observer, wireless operator/air gunner and an armourer whose function was to try to keep the cannon working—these weapons were never known to fire more than five rounds consecutively. The armourer in the commander's aircraft was Air Mechanic Juul.

Classic digititis prevailed when the navigators in the accompanying aircraft left the navigation to the commander's plane. Anyone who has been in the region of Kufra will know that the terrain is singularly featureless from the air. There was no DF equipment available at Kufra, and owing to an error in the DR plot of the leading aircraft the flight lost themselves.

As fuel was running low the three aircraft landed in the open desert and the commander's was refuelled from the other two. It then took off to try to find Kufra. It was actually heard flying over Kufra but unfortunately a sandstorm was blowing at the time.

Nothing further was heard at Kufra for nine days. On the ninth day a Wimpy—the last aircraft taking part in the search—heading back to Kufra spotted the "mystery" Blenheim on the ground and landed beside it. Juul was the only person still alive and had been without water for most of the period. Ironically enough, an Arab tracker with the Wimpy indicated a water hole in the ground a matter of 150 yards from the Blenheim's wing-tip.

The other two Blenheims of the flight were discovered about a week later at approximately the same radius from Kufra but about 90 miles from the commander's aircraft. All eight members of the two crews were dead. Later, one of these aircraft was flown back to Kufra and the other one was broken up and the parts returned by truck.

I would like to mention that numbers on the aircraft in question give no clues, as this Blenheim was sent to Kufra when it still possessed its RAF markings. There was some talk that these IVFs had been specially modified for use in Crete, but the outstanding point about them is the fact that their condition when received by 15 Sqn was so bad that wire was used extensively to hold various bits and pieces together during the El Alamein retreat.

One last point of interest is that the starboard leading-edge wing root can be seen in one photograph to have a special modification to assist in preventing root stall. I worked on this particular device on the aircraft in question.

From time to time since the war I have seen mention of Heinkel 111 remains being found around the outskirts of Kufra. This was due to the accuracy of the machine-gun fire by the forces at Kufra during 1942. On one particular day in September 1942 twelve Heinkels attacked us and eight were shot down.

Although a detached flight of 15 Sqn was at Kufra for the year that it was the HQ of the LRDG only 216 Sqn, RAF, is mentioned in any of the books written about the LRDG.

Cape Town — D. BURCHELL

"Two-Six!"

I FIRST heard the phrase "Two-six" used at Martlesham Heath in 1920. Its source and significance were never in question, at A and AEE at any rate. It was always used when pushing hangar doors or doing any heavy job requiring team work and it was assumed that from "one, two, three, heave!" the phrase had been filleted to "two, six" by way of "two, four, six."

Airmen always had a propensity for varying both terms and etymology.

Farnborough, Hants — E. W. S. BERRY

FORTHCOMING EVENTS

April 20-22. Institute of the Aeronautical Sciences: National Symposium on Manned Space Stations, Los Angeles.
April 20-24. Constantine Aero Club Rally.
April 22. RAeS Agricultural Aviation Group: "Pilot Training," by Capt Richard Bradbury and J. M. McMahon.
April 27. Kronfeld Club: "The History of the Royal Observer Corps," by H. Gorden.
April 28. British Interplanetary Society: "High-altitude Chambers and Pressure Suits," by Dr E. W. Still.
April 28. Institute of Transport: 1960 Congress, London.
April 30-
May 8. Rally and Second-hand Aircraft Sale, Cosnes, France.
May 3-13. Mechanical Handling Exhibition, Earls Court, London.
May 4. British Institution of Radio Engineers (Computer Group): "Computer-controlled Television Displays for Flight Simulators," by J. N. Naish.
May 4. Kronfeld Club: "Army Aviation, Past and Present," by Maj P. A. Downward.
May 5. RAeS: Annual General Meeting.
May 6. RAeS Rotorcraft Section: "The Personal Helicopter," by J. S. Shapiro.
May 6-8. Shackleton Sales Weekend, Kidlington, Oxon.
May 9-11. Institute of Welding: Spring Meeting.

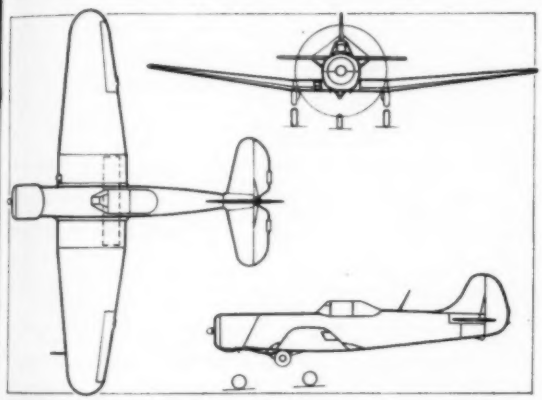
RAeS Branch Fixtures (to April 29): April 27, *Christchurch*, a.g.m. and "Operational Problems in Supersonic Flight Testing," by Wg Cdr R. P. Beamont; *Coventry*, a.g.m. and Film Show; *Hatfield*, "Supersonic Transports," by D. G. Brown; *Preston*, "From Aviation to Astronautics," by J. E. Allen; *Weybridge*, a.g.m. April 28, *Yeovil*, a.g.m.

Sport and Business

US executive for Germany (1): a Lockheed JetStar (four Pratt & Whitney JT12 turbojets) has been ordered by the Fried. Krupp organization of Essen for delivery in March 1961. This picture is of the first prototype; a second is also flying and the first production model is due to fly in July

GLIDING ACCIDENTS during 1959, reported by the British Gliding Association's accident analysis officer, Air Cdre G. J. C. Paul, at last month's annual general meeting, caused damage amounting to £8,332. The total number of reported accidents was 90, of which 16 involved pilots with less than five hours solo, 38 involved pilots with more than five hours but below Silver C standard, 11 involved Silver C (or above) pilots, and 14 were attributed to instructors. The remaining 11 took place on the ground. Referring to the damage caused by pilots in the second of the above categories, Air Cdre Paul suggested that the cause was a combination of two factors: (1) post-solo supervision and advanced instruction were inadequate, and (2) inexperienced pilots were getting on to expensive aircraft too soon. Among the minor accidents was one (costing £2) caused by a T.21 instructor who "failed to avoid tea urn on own airfield."

Air Cdre Paul also presented an analysis of the 671 gliding accidents reported during the ten-year period 1950-59. Of these, 53 were caused by heavy landings, 46 by "inability to deal with cable break or winch failure," 45 by "loss of control due to slow approach, including stretching the glide," and 44 by undershooting



The Yak-18P club and aerobatic version of the two-seat Yak-18A trainer. Powered by a 260 h.p. AI-14R nine-cylinder radial, the single-seater has a span of 34ft 10in and a sea-level top speed of 170 m.p.h.

the landing area. A general division into phases of flight showed 100 accidents during or immediately after launch, 50 during flight, 162 during the approach, 248 on landing, 76 on the ground and 35 during hops and slides.

A WHIRLWIND HELICOPTER operated by Bristow Helicopters is being hired by Marley Tile Holding Company for a trial period of three months as an executive aircraft. The machine will fly between the company's headquarters at Sevenoaks and its factories near Barnstaple, Devon; Bridgend, Glamorgan; Cheltenham, Glos; Frome, Somerset; Guildford, Surrey; Leighton Buzzard, Beds; Maidstone, Kent; Poole, Dorset; Pulborough, Sussex; Reading, Berks and Romford, Essex.

ACCIDENT STATISTICS for light aircraft in France during 1959 show that a total of 293 accidents occurred, out of a total of 3,070 aircraft in service. Data on individual types include: Jodels, 825 in service (116 accidents); Stampe, 490 (27); single-engined Pipers, 290 (32); Norecrin, 170 (14); Tiger Moth, 165 (8); Emeraude, 140 (31); SIPA, 90 (11); NC, 50 (4); Minicab, 50 (1); miscellaneous, 800 (44).

US executive for Germany (2): this Beechcraft Model 65 Queen Air (two 340 h.p. Lycomings), the first of its type to be exported, has been delivered to Rochlingsche Eisen und Stahlwerke of Volklingen. The new machine succeeds a Twin-Bonanza which the company previously operated; in the photograph are Allen Pepin (left) of Travelair GmbH, Beech distributors, and Capt Helmut Jakobs, Rochlingsche pilot

A GRUMMAN GULFSTREAM has been ordered by the Anglo-American Corporation, a South African mining concern, for delivery in August. The corporation at present operates a D.H. Dove and Heron.

A SERIES of demonstration flights will be made by the Morane-Saulnier 880 Rallye during May. Having logged over 40 hours' flying time, the prototype has completed the company's flight-test programme and is at present undergoing further tests at the Bretigny Flight Test Centre. Powered by a 90 h.p. Continental engine, the 880 is an all-metal three-seater (available with either nosewheel or tailwheel landing gear) with a range of 435 miles and a cruising speed of 105 m.p.h.

NORTHERN SCHOOL OF AVIATION FLYING CLUB is planning to hold an At Home and flying display at Squires Gate Airport, Blackpool, on Saturday, May 28. Admission is by invitation only; further details are obtainable from the club at Squires Gate.

NOW UNDER CONSTRUCTION at Eastleigh, the third Currie Wot built by Hampshire Aeroplane Club may be fitted with a Pobjoy engine and entered in this year's British Lockheed international aerobatic contest.

A HIGHER-POWER VERSION of the Potez 4E engine, developing 105 h.p. in place of the original 90 h.p., is going into series production. Flight testing is being carried out with the unit installed in a Jodel D.100 Ambassador.

FLIGHT TESTING of the Merville S-31 experimental high-performance sailplane is now being carried out under the supervision of Pierre Bonneau. This 18-metre machine, developed from the Cartier S-30 and built by the Merville company, made its first flight during January at Chavenay.

THE BRITISH GLIDING ASSOCIATION is considering the possibility of establishing a centrally located training school for glider instructors, which would provide courses for new instructors and refresher courses for existing instructors.

RETROSPECT

From "Flight" of April 23, 1910

A Flyer's Caravan: On Monday, Mr. Somers Somerset, who is practising on a Henry Farman machine at Chalons, surprised his fellow pupils by arriving at the camp in a fully-equipped gipsy caravan which he had purchased at a fair at Rheims. Mr. Somerset proposes to live in this house-on-wheels while he is taking his lessons, and thus be independent of anyone else. He hopes by this means to solve the early rising problem, in order to meet the new regulations which have been imposed by the military authorities.

RAF ON THE ROCK

Gibraltar's Peacetime Significance

THERE is a curious but charming dichotomy about Gibraltar. English goods and prices in the shops, Spain ten minutes' walk away; red pillar-boxes and English-style policemen, but across the straits the blue outlines of Tangier softly reverberating under the North African sun; Barbary apes and Bournemouth accents; a great rock towering up to 1,394ft at the edge of the western Mediterranean, with no room at its foot for an airfield, but a wide 2,000yd runway sticking defiantly out into the sea.

Britain has always managed somehow to do the impossible in Gibraltar. In 1704 she took it (with Dutch assistance) from the Spaniards, who had made the fortress impregnable, after a three days' siege; and in the 1780s retained it despite French and Spanish batterings during a three years' siege. At the start of the Second World War this British outpost on the southern tip of the Iberian peninsula had only a minimal airfield, a converted racecourse with 200yd run, the RAF operating flying-boats from the harbour; but by 1942 a 1,550yd runway had been built (the racecourse disappearing in the process) and 950 aircraft were parked on it when Operation "Torch"—the North Africa landings—was mounted from Gibraltar, a dramatic justification for Britain's grip on this strategic stronghold.

This was the crescendo of Gibraltar's aerial activity during the war: Hudsons, Wellingtons, Beaufighters, Catalinas and Sunderlands operated from there; Hurricanes and Spitfires were assembled there; American aircraft landed on their way from West Africa to the UK, and British aircraft on passage from the UK to the Middle East and beyond. Because of German control of France, this foothold in Southern Europe played an indispensable part not only as a staging-post but as a base for the offensive against U-boats and the protection of convoys on sea routes binding the UK to its Commonwealth.

Gibraltar's contemporary significance as a staging-post is potentially great, for should the troubles in Africa increase it would again prove an invaluable stepping-stone. Its prime importance at present is as a centre for maritime patrol activities, with operational areas extending westward and eastwards. Operational control is exercised by Coastal Command through Air Headquarters Gibraltar, which is responsible for policy and all operations, national and NATO; while day-to-day administration is the responsibility of RAF station North Front. The badges of both formations display a key, in one case backed by a turreted castle and in the other by heraldic waves.

The Air Officer Commanding, Air Cdre R. B. Thomson, has a triple function to perform. He sees that Coastal Command policy is implemented; he is responsible for the RAF contribution from Gibraltar to the NATO forces; he represents the Royal Air Force in its dealings with civil and Service organizations of the many nations with interests in this key area, and acts as adviser to the Governor on air defence matters.

Gibraltar is one of those toeholds on oversea soil, like Aden and Hong Kong, which provide Britain not only with refuelling bases for ships and aircraft but also with centres from which her influence may be exercised; and the gateway to the Mediterranean, a stronghold whose advantages have been proved by history, is no mean vantage-point to possess.

Physically, RAF strength at Gibraltar (like that of all the Services there) is small: one squadron of Avro Shackleton MR2s, No 224; a marine craft section of three launches; and a peacetime establishment of about a thousand men to give backing for these and other activities. But the symbolic and potential importance of the base, bestriding Britain's main eastbound shipping routes, is much greater than its size; and its responsibilities are wide—as wide as the range of its aircraft. Operational areas for the Shackletons extend westward into the Atlantic and eastwards into the Mediterranean, upholding Gibraltar's responsibilities to EASTLANT and AFMED headquarters in these areas. During NATO exercises, co-operation with the air and sea forces of France, Portugal and the United States is practised.

Gibraltar airfield, like many of Britain's overseas bases, is used by both Service and civil aircraft; but it is owned, controlled and administered by the RAF. Shackletons and visiting RAF aircraft, BEA and Tangier Airways and civil and military machines from other countries operate from its runway (which because of its width always looks from the air shorter than its 2,000yd length). Movements of RAF aircraft are on the increase and the monthly figure has been known to reach 1,000. A handsome new terminal building, equipped to handle both civil and RAF passengers and freight, was opened about a year ago.

For most of the time, Coastal Command aircraft carry out their activities unseen and unsung—perhaps even more silently than the Silent Service: they do not demonstrate in formation aerobatic teams, nor have they the V-contours which would put them in the height of fashion; but occasionally a Shackleton—one of the most versatile of aircraft—pops into the news, and two recent cases provided by No 224 Sqn are worth recalling. One was in relief work for the earthquake-shattered town of Agadir, when the Shackletons carried in blankets, rations, medical supplies and chemicals and brought out survivors, and the squadron made a personal gift to survivors of 10,000 cigarettes; and the other when

By HUMPHREY WYNN

two of the aircraft on a routine 14-hour training flight during February dipped in salute over the *Capetown Castle* and radioed greetings to the Prime Minister, on his way home from South Africa.

The aircraft operated by No 224 Sqn are MR2s and it seems unlikely that under present circumstances they will be replaced by MR3s. The 2 is able to work at full capacity from Gibraltar and capably does all that is required of it. The more sophisticated 3 requires a larger safety margin in runway length and other factors, though under wartime circumstances it could be employed operationally from Gibraltar.

Winds at the airfield provide unusual hazards with the great rock on its perimeter acting like a baffle and producing unexpected local currents, the worst effects being when the wind comes from south-easterly or south-westerly quarters. There is also a persistent risk of fog, and a local meteorological phenomenon is the Levanter, or east wind, when a cloud formation sits on top of the rock—often for days at a time, producing a depressing effect upon the population.

As well as training for their operational task, location and destruction of enemy maritime forces, the Shackletons of No 224 Sqn keep an eye on peacetime movements of shipping traversing the busy mercantile thoroughfares between the Atlantic and the Mediterranean. They also maintain a constant standby to carry out air-sea rescue operations, and in this noble task are supported by the North Front marine craft section, one of whose new launches can go out for a distance of 325 miles and attain a speed of nearly 40kt.

RAF North Front, commanded by Gp Capt A. S. Baker (until recently CO of No 224 Sqn, having been succeeded in that appointment by Wg Cdr B. Lewin), is now a well-developed and up-to-date station—greatly different from the wartime airfield with its austere conditions. In recent years much new accommodation has been built, and this has gone a long way towards making a Gibraltar posting a welcome one. The tour is 2½ years; married men can have their wives out and quite recently members of the WRAF have gone to serve at the Rock for the first time. The mild climate makes life pleasant, and even if the town's physical limits must seem confined, Spain is over the border and North Africa across the water. That Gibraltar is not confined culturally was evidenced by a recent edition of the station magazine *Roundel*, which contained a perceptive article on Marcel Proust. The old fortress clearly is alert to the outer world, in both its past and present manifestations.

Air Transport as a "System"

A PLEA FOR SOME NEW THINKING - - - - by J. E. D. WILLIAMS

WIDELY known as an authority on air-transport operations and equipment, "Jed" Williams is consultant to a number of international airlines. Among his best-known papers are "Navigational Aspects of Turboprop Operation on the North Atlantic" (1958), and "Britannia—An Operator's Report" (1958)

WHEN primitive Man made himself a club it was probably for his own use. He was the manufacturer *and* the operator. As civilized society developed, the manufacturer and the operator separated, and simple communication failure prevented functional design. A classic example is kitchen equipment: the wealth amassed by its manufacturers means that they never have to use it themselves. This type of failure is easily overcome by direct communication between operator and designer; in the aviation industry the principle is widely appreciated, even if not always faithfully applied.

Care must, however, be taken to distinguish between communication failure and development failure. Communication failure could not, for example, be blamed for the bad design of the toilet in one aircraft in which the writer recently flew, for it is presumed that the designer was an experienced operator of such devices in general. Development failure occurs because the operating characteristics of the product are imperfectly understood before it is committed to operation. In the manufacture of aircraft and engines, the correct principles are of necessity now so widely applied that optimum development, in a purely engineering sense, is a technology in its own right. The same cannot generally be said of the equipment put in aeroplanes. From seats to sophisticated electronic devices, development failure is too common. In this respect British manufacturers have an unfortunate reputation which is not always unmerited.

These problems of communication and development are common to all manufacture in civilized society and are fairly easy to solve once the problems are understood. A more subtle difficulty is the definition of the operational requirement.

Defining the Requirement

In transportation the most striking examples of this difficulty are to be found in navigation. From Roman times (and perhaps earlier) navigators have had ideas about latitude-determination at sea, but accurate longitude-determination had to wait for Harrison's clock, which was proved effective in 1762. Thereafter latitude and longitude could be separately determined at sea provided the sky was clear at the right times. The astronomical position-line was not to be invented until the nineteenth century, and then almost empirically, by a practical navigator who was lost! The essential concept of the position-line would have been perfectly elementary to the mathematicians of the preceding two centuries, and communication was well established. Navigation had been one of the purposes of the Royal Society and even Newton had interested himself in its problems; indeed, it had given a major impetus to mathematical and astronomical studies in those centuries. The reason for this strange omission by whole generations of scientists is simple: no one invented the astronomical position-line because no one knew it was needed. No one asked loudly or insistently enough, "What is navigation *for*?"

Fascinating historical parallels are to be found in some of the discussions at IATA and ICAO conferences, or in the system philosophy of certain navigation systems currently marketed. It is interesting to note that while some clever navigation devices flourish or wilt according to the effectiveness of this pressure group or that, the radio compass is a device that was instantly recognized and accepted. The reason it is still nearly universal is that, for the first time in air navigation, the operational requirement was squarely met. The radio compass did not do the job well enough, but it did do the right job.

In the simple case of the position line the hidden assumptions on the operational requirement could have been detected if people at that time had been aware of the danger. In the most sophisticated modern problems this ceases to be true unless the statement of the operational requirement is so general as to be useless. The core of the difficulty in advancing air transport technology is that any statement by an operator of his requirements for one system must contain intricately interrelated assumptions on the finished design of many other interacting systems if it is to guide the designer. The difficulty is not fully appreciated.

One has heard manufacturers express disappointment (at IATA's annual technical conferences for example) that in such difficult areas as the navigation/ATC/communications complex they can get no clear statement of the operational requirement. This is naïve. Operators express their operational requirements in terms of the systems they have. Henry V may have stated an operational requirement for sharper arrowheads before Agincourt, but he could not have specified 20mm cannon.

The familiar concept of "weapon system" design opens the way to advanced technological solutions to operational problems. One does not specify the requirement in terms of current systems, but ideally goes back to the ultimate requirement, and starts designing from there. In current practice one no longer decides to build a faster bomber; design an aircraft in isolation from the rest of "the system"; fasten on whatever seem to be the most suitable engines, armament, navigation and communications equipment independently designed by other people for unspecified vehicles; fill any remaining space with bombs; and finally hand over the result to military operators for any odd job they see fit. Nowadays airframe, engines, navigation (sometimes called guidance) and weapons are designed as components of a weapon system.

This concept of systems as components of systems, the ultimate system satisfying the requirement, is easy to understand but difficult to apply. The formal development of a "general method" of operations-requirement analysis and system-design will be an advance of historical importance—perhaps the first step towards a general theory of the solution of practical problems.

So far the only really complicated problems to which system-design has been applied concern weapons. With present methods it seems to the outsider (who pays for it) that one essential ingredient of effective weapons systems design is money, in incredibly vast quantities. It also appears (to the outsider) that there must be some other essential ingredient, as yet undefined, because some results indicate that money alone is not sufficient.

Clearly, to contemplate a design for air transport as a *system* is meaningless because a system must have a defined function. From the news pages of *Flight* one gathers that the operational requirement is to keep flags flying, political planners planning, members of trade unions employed, manufacturers in business, and so on. There is actually a minority which thinks that the object is to provide a service to people who want to travel about. In the real world—where one wretched traffic right may be a matter for a Cabinet decision—this aspect sometimes appears inconsequential.

Even if air transportation is not a system, the vehicle and its operating environment (airports, ATC, ground operations, etc.) do form one. The technical requirement can be stated in terms of economics, performance and safety. A design for this system is impractical at present, but it may become necessary sooner than we think. A preliminary design study might start with a survey of the component sub-systems in current use, examining their purpose and the way in which they fit the requirement. Where the fit is found to be poor it might be inquired whether simple communication or development failure have occurred, or whether the operational requirement is misunderstood. The design of basic components is limited by the state of the art; the design of our component systems is limited by our failure to know what is the state of the other chap's art.

[*A further article will consider the requirement for a navigation/air traffic control/communications system.*]

THE PRINCIPLES OF DRAWING

Know How to Draw, by Max Millar. B. T. Batsford Ltd, 4 Fitzhardinge Street, London W1. Price 12s 6d. Illustrated.

WE recently reviewed (March 4) a book on drawing aircraft. In Max Millar's book the drawing of aeroplanes is touched upon only briefly; but aeroplanes are just as subject as anything else—often more so—to the basic rules of draughtsmanship, and here those rules are explained and illustrated with extraordinary clarity. The author is no mere dilettante; he has had 40 years' experience as senior editorial artist of Iliffe & Sons Ltd, and all readers of *Flight*, *The Autocar* and other Iliffe journals will be familiar with the cutaway and other drawings which Mr. Millar and his staff regularly execute. As might be expected, the book has a slight bias towards the drawing of technical subjects, and therefore it is one that the young illustrator in industry will find helpful, especially as there is also a short section on the principles of pictorial printing.

THE INDUSTRY

Uncomfortably reminiscent of the dentist and his instruments is this photograph taken in the new "super-clean" area added to existing clean-room facilities at Sperry's Brentford, Middlesex, factory. The employee is working on a Rotorace gyro unit of the CL.11 compass system. Air filtration for the area excludes particles of greater size than two or three microns, temperature is controlled to within plus or minus 2°F, and the humidity limit is 40 per cent

In the control room of the aircraft valve testing chamber now being used by the Saunders Valve Co Ltd at their Hereford works are two-pen pneumatic recorders by Honeywell Controls Ltd. They give a continuous record of flow and of the pressures on each side of the valves under test

Plessey System for VC10

A CONTRACT valued at over £700,000 has been received by the Plessey Co Ltd for the supply of generating systems for the Vickers VC10s for BOAC.

This order follows a new licensing agreement recently concluded between Plessey and the American Westinghouse Corporation, which allows Plessey to produce—and market throughout the world, apart from US territories and Canada—Westinghouse aircraft electrical generating systems.

Skin-damage Identification

IN *Flight* for March 25 we illustrated an instrument known as the Sortationer, which, made by Townson & Mercer Ltd of Beddington Lane, Croydon, Surrey, is designed to differentiate between various aluminium alloys, magnesium alloys and copper alloys by indicating the conductivity difference of the surface layer.

One of the many applications of the instrument is in recognizing materials which have been heat-treated, and in this connection we have lately heard from the manufacturers that the aircraft industry is finding the Sortationer valuable for identifying areas of skin that have been damaged through the over-heating of de-icing equipment. The instrument makes it possible to delineate the exact area that will need to be cut out and replaced.

Mechanical Handling Film

A NEW 16mm sound/colour film, *Accent on Mechanical Handling*, had its first showing in London recently. Based upon sequences taken at recent Mechanical Handling Exhibitions (the next will take place at Earls Court, London, from May 3 to 13), the film depicts one or more examples of each of the various types of mechanical handling equipment, and a commentary by Bob Danvers Walker describes the classes of goods they are designed to handle. Action shots show many of the exhibits in operation.

The film, which is intended for world-wide distribution, is available free on loan from *Mechanical Handling*, Dorset House, Stamford Street, London SE1.

"Jet" Snow-dispersal

THOUGH primarily designed for use on roads, an ingenious new snow-clearing machine should be equally useful for airfield runway and apron clearance. Known as the Snow Locust, it is a diesel-driven vehicle on the front of which is mounted a battery of gas-oil burners with the aid of which is provided a blast of heated compressed air that speedily melts the snow. The vehicle is also equipped with rotary brushes.

The makers—Mobile Jet Dispersals Ltd, Benwell Lane, Newcastle-upon-Tyne 5, claim that the Snow Locust "carves an 8ft road through snow, ice and drifts, packing up to five miles into every hour . . . at an all-in cost of 35s per hour." A larger "country" model operates at a cost of 5s per hour.

IN BRIEF

At the British Exhibition in the New York Coliseum from June 10 to 26 the Dowty Group is showing hydraulic landing gear as used on the Fokker Friendship, a Rotol propeller and a Dowty fuel system.

A. D. Wenzel, who last July was appointed managing director of the Firestone Tyre & Rubber Co Ltd in England, has now also been made chairman of the board.

M. Haddon-Grant, LLB, has been appointed assistant secretary of the Plessey Co Ltd. He was formerly secretary and legal officer of Petfoods Ltd, one of the Mars Group of Companies.

A Dagenite sales depot has been opened at London Airport. Described as "the first battery service depot in the British Isles to cater exclusively for the needs of a busy airport," it is located in Building 203D, Eastern Perimeter Road, London Airport (tel Skyport 4321, ext 6023).

The retirement is announced of Robert D. Umpleby, who has been director in charge of piston-ring production at Hepworth & Grandage Ltd at Bradford and has played a notable part in the company's development during the past quarter-century. He joined Hepworth & Grandage 36 years ago and became a director in 1942.

George Wilmott, a service engineer of Normalair Ltd, left for India recently to act as the company's technical representative there. Based initially in New Delhi, he will be available as consultant on all Normalair-equipped aircraft within the area embracing India, Pakistan, Malaya and Burma. He will also give technical assistance and maintain liaison with the company in Yeovil.

J. R. Turrill has been appointed general sales manager of R. B. Pullin & Co Ltd, with the following specialist staff: I. H. M. Campbell, sales manager, motors and servo-components; R. W. Jelbart, sales manager, thermostats division; A. Wolstencroft, sales manager, sub-contracts and special products; and G. B. Jeffery, technical manager, control systems.

An agreement has been signed in New Delhi between the Indian Government and Marconi's Wireless Telegraph Co Ltd, for co-operation in the local licence-manufacture of Marconi-designed equipment. The agreement will form the basis for Indian manufacture of equipment in the aeronautical radio, radar and other fields, the range of aeronautical radar equipment having particular application to the Avro 748 being produced at Kanpur.

Clinical cleanliness is very much in the news; here is seen part of the clean area in the gyro laboratories of Elliott Brothers (London) Ltd, where floated-gyro techniques are being developed. The gyro bearings are floated in Fluorolube, a derivative of fluorine

Here is the first fuselage section of the D.H.121, which arrived at Hatfield from Portsmouth on April 5. It is shortly to be offered up to the Hatfield-built nose section, a photograph of which was published on March 25

AIR COMMERCE

SUPERSONIC BRINKMANSHIP

FEW really new ideas emerged from the "long consideration and great thought" given by the Air League of the British Empire to a radical policy for "British world pre-eminence in the air." In some instances the recommendations contained in the League's report* have already been overtaken by events. And it cannot be denied that some of their proposals—for instance, for an automatic air traffic control system and for automatic landing—are likely to come to fruition regardless of any statement of policy by the Air League or anyone else; the demand exists so clearly that active steps are already being taken to satisfy it (see "Sharing his Experience," page 576).

But perhaps a more charitable view of the Air League's hard work is to assume that their purpose was to formulate a policy based on the best current ideas in the British air transport and manufacturing industries. The League posed the questions:—

Should Britain embark upon the development of a supersonic air transport?

If so, what sort of an aircraft should it be, and in particular what should be its speed?

Are cheap air fares the clue to a really great expansion in air traffic and, if so, what kind of an aircraft is best fitted to carry such traffic?

What are the possibilities of a vertical take-off and landing technique as a major step forward in aviation?

What is the impact on public opinion of the increasingly noisy performance that must be expected as aero engines get more and more powerful, and unless special techniques are developed for quietening them?

Can this country, having regard to its climate, afford not to develop fully automatic landing facilities?

What measures can and should be taken to ensure greater safety in the air in the era of high-speed flight, when accurate split-second decisions may make the difference between an uneventful journey and disaster?

The recommendations which answered some of these questions were devised by a committee of eight under the chairmanship of Sir Miles Thomas. Its members were: Gp Capt Douglas Bader; Ivor Bowen; Air Chief Marshal the Hon Sir Ralph Cochrane; Aidan Crawley; Dennis Handover; Sir Archibald Hope; Air Chief Marshal Sir George Pirie; and Lord Shawcross.

It is clear that this august committee see as one of Britain's major contributions to transport aircraft the development of vertical take-off and landing through jet-lift and autostabilization. It is jet-lift VTOL that is proposed for a subsonic short/medium range Air Bus; vertical take-off development with the Fairey Rotodyne and helicopters is recommended as a stepping-stone to later VTOL airliners; and around VTOL, it is suggested, one phase of automatic air traffic control should be developed. Above all, it is VTOL that is proposed by the League for a supersonic, Mach 3 transport.

Alongside this demand for such a "seven-league" technological stride, other, short-term suggestions—development of a high-density Vanguard and a stretched and developed D.H.121 (now on the back of an envelope as the D.H.124)—pale into insignificance. It is the straight-up-and-down, 2,000 m.p.h. supersonic airliner "which Britain must use her special skills and experience to achieve" that is the *leitmotiv* of the Air League's 1960 report.

In opting for these capabilities the Air League were influenced by the fact that "at least one aircraft constructor in the United States is already well advanced in the design of a transport aircraft which will cruise at Mach 3 and . . . is confident that this higher speed is possible using new materials with which the Americans are already familiar and employing known designs and construction techniques." How was Britain to meet this competition other than by participating in an American project? Only, the report states, by entering the realm of Mach 3 plus VTOL—"a dramatic jump . . . which would place her ahead of her rivals in the supersonic transport field." And having said that, the League supports its case with arguments for the design: the elimination of a retractable undercarriage and braking gear; the ability to dispense with thrust reversers; the advantage of a wing uncompromised by the need to provide adequate control at take-off and landing speeds; and the diminution of heavy fuel reserves for holding.

Could a VTOL Mach 3 airliner, one wonders, *really* be suitable for stage lengths "from a minimum of 750 miles to the longest current intercontinental and transocean routes now flown"?—over the Pole, for example? Would failure to tackle such a project—as the League suggests—be nationally catastrophic? Or would catastrophe occur in attempting to apply the still-new technique of VTOL and yet-to-be-achieved speeds of Mach 3 to the first, ultra-difficult supersonic airliner?

A steadying touch of the brake to our supersonic aspirations has recently been applied by those who, technically speaking, ought best to know the problems—Sir George Edwards, managing director of Vickers-Armstrongs (Aircraft); Morien Morgan, chairman of the Supersonic Transport Aircraft Committee and scientific adviser to the Air Ministry; and Beverley Shenstone, chief engineer of BEA. Their advice was recently summed up in a pithy remark of Sir George's to the effect that "If the industry bites off more than it can chew, it will fall flat on its face."

May we suggest that, in planning the supersonic airliner, two principles should be borne in mind? Speed has always been a saleable air transport commodity, but not at any price in economy. Mach number, VTOL and other innovations must be related to capital and operating cost and thus to the price of the airline ticket. This is as true of the subsonic airbus as it is of the supersonic airliner. The other point is that economy is always a saleable commodity but not at any price in safety. VTOL notwithstanding, the prestige value of Mach 3 should be carefully weighed against the questionable wisdom of technological brinkmanship; not to do so would risk not only a £200,000,000 engineering folly, but unnecessarily jeopardize progress in safety too precious to measure in monetary terms.

A. T. P.

*The Future of British Air Transport, published by the Air League of the British Empire, Londonderry House, 19 Park Lane, London W1.

More dressing gown diplomacy as Lord Douglas, chairman of BEA, is awakened at 7 a.m. by London Airport residents remonstrating about jet noise. There are conflicting reports about whether Lord Douglas (who was hardly allowed to put his point of view) shut or slammed the door on the delegation

Reports that Mr Kruschev would buy 12 Caravelles were later dampened by explanations that the condition was that France should buy Tu-104s. Here the Russian leader's pilot samples the pride of the French industry for himself. For a sample of East-West cockpit demonstration in reverse, see page 557

AIR COMMERCE . . .

GOODBYE BOAC ARGONAUTS

WHEN BOAC Argonaut G-ALHG *Aurora* landed at London on April 8, the commander, Capt E. N. Wright, completed the last scheduled BOAC passenger service to be operated by this type of aircraft.

Canadair DC-4Ms, of which 22 were delivered to BOAC, went into BOAC service in August 1949. Altogether they carried 870,000 passengers and flew nearly 107 million miles. Now all of the remaining 20 have been sold—except one, which will be retained for the training of apprentices. Purchasers of BOAC Argonauts are Overseas Aviation, 9; Royal Rhodesian Air Force, 4; EAAC, 3; Aden Airways, 3.

SUPPORT FOR THE SUPER BROUSSARD

TWO new important steps have just been taken in the development of the MH.260 Super Broussard, Max Holste's twin-turboprop 30-seater feederliner. A number of airlines, in Australia and New Zealand for instance, are considering it seriously as a DC-3 replacement.

The French Minister of Transport, Robert Buron, has agreed to assist in the financing of the MH.262 Super Broussard. This new version will have the same general configuration as the 260, including Turboméca Bastan 960 b.h.p. turboprops, but it will be pressurized. The MH.262 will be available for delivery in 1961. M. Buron has authorized Max Holste to work with Nord-Aviation in the production of the aircraft.

SHARING HIS EXPERIENCE

TWICE as many pilots undershoot the runway as overshoot it. Following a serious number of landing accidents when the F-100 first entered USAF squadron service, and after visits to squadrons by test pilots had not achieved results, a film was made on how to land the F-100. During the following six months the landing accident rate dropped by 71 per cent. This information was given by Maj Gen J. D. Caldara, who is responsible for USAF flight safety, at a recent press conference in London. The general was in Europe making his annual tour of USAF bases. His remarks will be of interest to all those concerned with air transport safety.

On collisions, Gen Caldara noted that 1959 had been better for USAF aircraft than 1958. The application of fluorescent paint to all T-33s operating in one training area was followed by a 67 per cent reduction in mid-air collisions over the following six months. Nevertheless, a collision-warning device was a necessity and the Federal Aviation Agency had now realized this after first planning to rely on ground control for collision protection. Ground control involved additional possibilities of human error and altimetry was too inaccurate to form a basis for reliable vertical separation. Introduction of electronic collision-warning equipment was strongly opposed by the AOPA, who spoke for private and business owners, but it was their safety which was involved and they were themselves responsible for some near misses. The general said that the day of the "ham and eggs" private pilot was past. Airspace could not be cordoned off in levels, because all types of aircraft had to climb and descend.

On cockpit presentations, Gen Caldara said that he could see no reason why the pilot should not have a television-like picture of the ground and neighbouring aircraft, regardless of visibility, in place of the standard instruments which had remained virtually unchanged for 20 years. Supersonic airliners would not necessarily be less safe than present airliners, but they would absolutely require adequate air traffic control and accurate weather forecasting. Within five years the Federal Aviation Agency planned to have in operation a semi-automatic traffic control centre capable of handling the traffic then expected.

On navigation aids, the general said that the VOR channel spectrum was virtually saturated already. There were too few channels and the cross-pointer instrument was more difficult to use than a pictorial presentation. The straight-in let-down was necessary for jet transports and direct radar surveillance would be required.

The F-104 accident rate had been good considering how far the aircraft had been ahead of its time. It was flying at M2 in 1957 and in the general's opinion was a pleasant machine to fly. For every operational squadron which had suffered an accident, two more had not. In a jet aircraft, only jet experience counted from the safety point of view. No amount of piston-engined experience could help a pilot in trouble in a jet. If a pilot was going to fly jet aircraft, he must fly them often.

The USAF KC-135s had suffered no accidents or incidents similar to those encountered by civil 707s. No undercarriage trouble had been experienced, despite the fact that the KC-135 undercarriage was lighter and had to bear greater weights.

INDEPENDENT SIX-POOL

NO surprise to readers of *Flight* will have been the announcement last week that six British independent airlines have been holding what are described as "very tentative discussions" about the possibilities of pooling their resources. The idea was first publicly mooted by Gp Capt Wilcock, MP, chairman of Derby Aviation, in an interview with Frank Beswick in *Flight*, February 19, and the issue was raised again by C. J. Stevens, managing director of BKS, on page 482 of *Flight*, April 8. Gp Capt Wilcock is reported to be chairing the exploratory committee. The airlines involved are most of the scheduled service operators not affected by recent amalgamations—BKS Air Transport, Cambrian Airways, Derby Aviation, East Anglian Flying Services (Channel Airways) and Jersey Airlines.

Co-operative effort does not extend to financial mergers and each of the six will for the moment retain its identity and independence; the new grouping is seen as a means of exploiting services both on European routes and domestically within the British Isles—an area which we recently tried to show (April 8, 1960) is not particularly well supplied with regular, all-the-year-round air services. Between them the six provide quite good regional coverage (in the airline order given above spheres of influence are: the north-east; Wales and the west country; midlands; south-east; and south) and a joint scheduled capacity of about 90 per cent of the independents' domestic total.

Not included are Silver City, whose future plans for developing a north-west European network are still uncertain, and two other small scheduled operators—North-South Airlines and Don Everall.

Co-operation can be expected to extend to joint maintenance, aircraft interchange, ticketing and handling, but the report that a fleet of 50 Avro 748s (three of which are to be purchased by BKS) or Dart Heralds would be ordered seems premature. Pooling of resources is intended eventually to make possible the purchase of new equipment, not as a means of exploiting it.

CAPITAL'S DAY OF RECKONING

THE timing of Vickers' demand to Capital Airlines for repayment "within three days" of £4.3m outstanding on their Viscount debts was significant: it came shortly after Capital's request to the CAB for a £4.6m subsidy (*Flight* last week). With "extreme reluctance" the chairman of Vickers-Armstrongs, Sir Charles Dunphie, told the president of Capital, David Baker, that "foreclosure proceedings" on the entire fleet [57 Viscounts, as well as its Constellations, DC-4s and DC-3s, all of which are mortgaged to Vickers] had been started.

Capital ordered 40 Viscounts in June 1954 and a further 20 in December 1954. Deliveries began in June of 1955. Total cost was about £24 million, financed by Vickers and Rolls-Royce, credit being reportedly guaranteed to the extent of 80 per cent by the Export Credits Guarantee Department. The agreement called for proceeds from the sale of equipment (which Capital has never been able to sell) to be set against debts, and for Capital's net worth to be not less than $10m. The contract has been renegotiated a number of times in favour of Capital, with "moriatoria" on repayments being granted. Because the airline could not enter into new capital commitments without Vickers' assent, the orders for seven Convair 880Ms and five Lockheed Electras included an arrangement whereby the US firms would help Capital to pay off its Viscount debts. This failed because of Capital's deteriorating financial position.

But Capital has lost more than £2m since 1956, and almost that

amount so far this year. The day of reckoning has come for this unhappy airline, whose Viscount order did so much to boost Capital's competitive position as well as Vickers' exports.

Will Capital get the requested subsidy? Not if one Democrat senator, Charles Vanik, gets his way. He considers that approval would constitute "an unwarranted dissipation of public funds and provide a reward for stupid management."

LACK OF IDEAS

THE problem of jet noise is not so much lack of money as lack of ideas, the Minister of Aviation told the Commons on April 11. Very little was known about the fundamental cause of jet noise, and there was a limit to the amount of money that could be devoted to basic research. But he had very great sympathy with those who were disturbed—"I heartily dislike noise and understand the feelings of these people." But he had to make it clear that "I cannot promise that aircraft noise will decrease in this age. What we can and what we must do is to try to keep it within bounds."

An exhaustive study of the whole problem was to be undertaken, but he could not promise that an answer could be found that would be satisfactory to "people who live on the edge of aerodromes." [See "Straight and Level," page 569.]

RAIL/AIR TO CALAIS

ON April 11, British Railways (Eastern Region) in conjunction with Air Charter's Channel Air Bridge inaugurated a new rail/air service for no-passport day trips to Calais. The railway provides fast electric traction to Rochford, from where a bus takes passengers to Southend Airport. The cost from the London termini, Liverpool Street and Fenchurch Street, is £4 6s 6d. The journey is completed in approximately two hours, of which about 30 minutes is spent in the air. On arrival in Calais the trippers have the choice of spending their time in the town, on the beach, or participating in coach tours.

For those who prefer it Air Bridge will still run their normal coach/air no-passport trips from London, a service which carried some 20,000 passengers last year. Speaking in the Calais Town Hall to a party of journalists and railway officials, who were passengers on the inaugural flight, D. A. Whybrow, manager, Channel Air Bridge Division, Air Charter, hinted that this new rail/air combination was only the beginning of much bigger things and suggested that although the joint fare was already low it could be made still lower. He hoped for the institution of longer—two or even three day—no-passport trips. Asked whether the service might not be overwhelmed by passenger numbers, he said that with their present fleet of five DC-4s and nine Bristol 170s he felt that the demand could be met.

Similar rail/air services are also available to Ostend and Rotterdam, at £4 18s 6d and £8 7s 6d respectively, but for these day trips passports are required.

COMET 4 TECHNIQUES

OPERATING techniques of the Comet 4 have been "reviewed and amended," according to the Parliamentary Secretary to the Minister of Aviation, Mr Rippon. Answering questions about BOAC Comet 4 incidents, of which he noted that there have been five, including four in the landing or approach phases, he said that these techniques would be "further examined when we hear the report of the fifth accident in Madrid."

Of the four accidents so far investigated, said Mr Rippon, none had been attributed to defects in the aircraft or in its engines. Mr Goodhew (Con, St Albans) asked Mr Rippon whether he was aware that his statement would be welcomed "by all those who think that the Comet 4 is the greatest aircraft in the world today for civil purposes."

REPRIEVE FOR LIVERPOOL AIRPORT

AFTER seven years of sporadic negotiations with the Ministry of Transport and Civil Aviation and the MoA, Liverpool City Council have at last decided to take over the airport at Speke.

The Minister's conditions for the take-over are: (1) Liverpool Corporation should undertake to manage and keep open the airport for a period of seven years; (2) during that time the Ministry would help by providing technical services free of charge; (3) fixed assets, other than electronic and other equipment used by the technical services, would be handed over to the corporation; (4) the corporation would receive all revenue from landing fees, rents and other charges; (5) it would bear operating costs apart from those of technical services; (6) it must safeguard the State's interest if it should ever be necessary for the State to acquire the airport; and (7) it must operate the airport directly and not through a third party, and must keep it licensed for public use.

These conditions are not as advantageous to the city council as those rejected in 1953, when the Ministry also promised financial assistance for capital development. Those then planned have since been carried out, so that the Ministry's forecast that "no appreciable capital development can be foreseen in the next seven years" may not be as important to Liverpool as it would have been to Manchester.

Paradoxically, the decision to make Speke a municipal airport may be the result of a proposal last February that the airport should be closed and the land used for housing. This aroused a storm of protest both from those who were directly connected with the airport and from the ordinary citizens of Liverpool. Thousands signed a petition opposing closure. But it would be unfair to imply that the city fathers, with the municipal elections a month away, were guided only by public opinion. In May 1959 Alderman John Braddock, chairman of the finance and general purposes committee, stated with some justification that, while he did not want Liverpool to lose what could be a valuable asset to the city, he did not wish to saddle the ratepayers with "a costly burden which at the moment is an airport only in name." Now

The Royal Aeronautical Society's Fifth Annual Air Transport Course took place at Oriel College, Oxford, from March 20 to April 9. Students and lecturers were:—

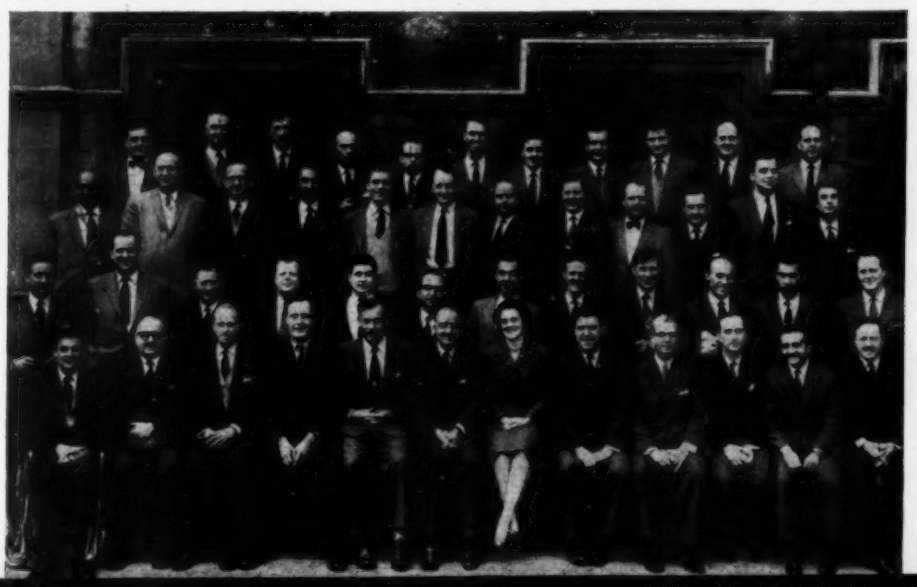
Front row (l. to r.): M. Fountain, Vickers; W. C. Leech, Rolls-Royce; R. R. Griffiths, BOAC; A. R. Barrowclough, lecturer (air law); S. F. Wheatcroft, lecturer (economics); Dr A. M. Ballantyne, RAeS; Miss E. B. Croad, RAeS; D. C. Tennant, lecturer (operations); F. C. Pike, Esso Export; G. A. G. Morris, DH Aircraft; Dr F. Leccese, Alitalia; R. Birkett, Skyways.

Second row (l. to r.): A. G. Edwards, BOAC; W. C. Wigmore, Esso Petroleum; S. A. Worthy, East African Directorate of Civil Aviation; A. J. Geraghty, Rolls-Royce Canada; R. A. Howell, English Electric; R. E. G. Davies, DH Aircraft; R. I. B. Tavener, Rolls-Royce; P. D. Stewart, BOAC; R. G. Thorne, RAE; N. Tommasi, Air BP; B. N. Basic, Yugoslav Air Transport; L. Fredrikson, Air BP, Sweden.

Third row (l. to r.): Capt D. A. Samant, Indian Airlines; O. B. Tomkins, TCA; K. Bentley, Vickers; T. A. Gawade, Westland; G. Jump, Rolls-Royce; J. P. Armstrong, Rolls-Royce; Dr A. Gross, Swissair; E. G. Barber, BOAC; K. C. Hopkins, Lloyds; Capt R. H. Tapley, BOAC; J. G. M. Williams, Hawker Siddeley (Advanced Projects); V. Schiro, Alitalia.

Back row (l. to r.): D. J. Masters, Fairey; H. W. Hedges, BEA; K. T. McKenzie, Fairey; E. M. Barbosa, TAP; M. F. Costa, TAP; D. N. Ker, CPAL; B. Mellor, Jersey ATC; R. W. Simpson, DH Canada; A. J. Smith, Bristol Siddeley; B. J. Watson, Blackburn Aircraft; J. A. Lorenz, Varig. (Not in the picture: K. G. Wilkinson, operations lecturer; B. H. Heafford, Napier

It began on April 11: air and rail linked on a common passenger ticket—the enterprise of BR (Eastern Region) and Channel Air Bridge (see story above)



James Gorman, assistant general manager of Aer Lingus, is met by the Lord Mayor of Bradford on the arrival at Leeds/Bradford Airport of his airline's inaugural service from Dublin earlier this month

AIR COMMERCE . . .

he thinks that the council should take Speke over. He believes that they will be able to run it successfully, not only justifying an extra 1½d on the rates because of the airport's advantages to the city, but, it seems, possibly reducing the estimated annual deficit of £68,000 if not turning it into a profit.

At the time Ald Braddock made his statement last May the only scheduled services from Speke were those of BEA and Aer Lingus to the Isle of Man and Ireland and Starways' service to London. A licence had been obtained for a new Starways service to Exeter and Newquay—the first to be granted for four years.

This year two new services have already begun and a third is expected in June. Dan-Air have started their service to Bristol; BKS are booked up for some weekends for their forthcoming car-ferry service to Dublin; and Overseas Aviation have obtained clearance from the French authorities for their proposed service to Paris. In addition, BEA are introducing Viscounts to deal with the increased traffic on their Liverpool-IoM-Belfast service, and Cambrian will be resuming their service to the Channel Islands. International non-scheduled services have also increased in number.

Although developments such as a new 8,000ft runway are theoretically possible at Liverpool, it seems certain that it will not be able to become the international airport of the North; Manchester has too great a lead. Speke has been handicapped by its proximity to Ringway and by allegations from BEA of material diversion to independent airlines of traffic originating in the Manchester area (*Flight*, April 1). Yet if the independents do obtain a greater share in the air transport of the nation, Liverpool Airport may yet justify the hopes of the far-sighted councillors who established it in 1933. E. J. R.

ARGENTINA'S LARGEST INDEPENDENT

TRANSCONTINENTAL, the only Argentine carrier apart from Aerolineas Argentinas to offer international services, have significantly increased their load factors since operating Britannias on services to New York via Sao Paulo, Rio de Janeiro and Caracas. Seat load factor on the Britannias in January 1960 was 46.2 per cent. In January 1959, when Transcontinental were operating L.1049 Super H Constellations, the load factor was 38.2 per cent, and these aircraft have been leased to another airline after only one year's use.

In 1959, 12,061 international passengers were carried at a year-round seat load factor of 52.6 per cent; December to March are off-peak months, as most people who travel north prefer to do so when it is summer in the northern hemisphere. If all goes as it should, the 1960 TSA seat load factor on international flights should be at least five or six per cent higher than the '59 figure. The Britannias are being used in a 104-passenger first/six-abreast tourist configuration, with IATA rates being charged although TSA are not members of that organization.

Transcontinental were the first airline to start operations in Argentina when the 1955 "caretaker" Government restored freedom of private enterprise to Argentina's airways. For cabotage services they operate four Curtiss C-46 aircraft designated "CW-20T Commuters" on inland services and regional flights to Montevideo and Asuncion. Over-the-Andes flights to Santiago de Chile are flown with Britannias. One of TSA's characteristics has always been the regularity of their daily flights, with their services leaving every day at the same time, thus avoiding the usual mental gymnastics on the "Mon-Wed-Fri" theme.

Transcontinental (writes a correspondent) have also managed to earn themselves a good name for courteous service at a time when air fares are very expensive in relation to average incomes in Argentina. Thus they have managed to keep their aircraft fairly full in spite of Aerolineas' more sophisticated equipment (pressurized Convair 240s and DC-6s released from international flights with the coming of the Comets).

FASTEST TO NEW YORK

INITIALLY, BOAC's London - New York Boeing 707-420 services, due to start on June 6, will operate on Mondays, Wednesdays and Fridays, returning on Tuesdays, Thursdays and Saturdays. Westbound scheduled flight time will be 7hr 20min and eastbound one hour less—the fastest times on the route. It is expected that on June 15 a daily frequency will be introduced. Formal acceptance of BOAC's first 707-420, following ARB certification, is imminent as this issue appears; as recorded previously, training—at present under way at Tucson, Arizona, with a pre-delivery aircraft—will be based at RAF St Mawgan in Cornwall.

Looking further ahead, on July 10 an additional 707 round trip will operate from London to New York via Glasgow at a thrice-weekly frequency, rising to four times weekly on August 13.

Soon after services begin, on June 18, the first weekly London - Montreal - Toronto service is scheduled, and four days later this will be supplemented by a London - Glasgow - Toronto service. On September 3 a weekly London - Glasgow - Montreal - Toronto service begins.

By the end of September BOAC's 707s are expected to be operating eighteen of the corporation's 50 weekly round trips across the Atlantic, progressively displacing Comet 4s, which will be diverted to other routes.

BOAC CHAIRMANSHIP SPECULATION

THE name of the recently retired Chief of the Air Staff, Marshal of the RAF Sir Dermot Boyle, is among those candidates—according to newspaper reports—short-listed by the Minister of Aviation as a prospective successor to Sir Gerard d'Erlanger, whose impending retirement was announced earlier this year.

Another candidate is the chairman and managing director of Short Brothers & Harland, Sir Matthew Slattery. It is understood that Sir Matthew has been on Duncan Sandys' list for some time. Another is Peter Masefield, who has just resigned his appointment as managing director of Bristol Aircraft. Mr Masefield was chief executive of BEA until his appointment with Bristol at the end of 1955. Prior to that he was the British civil air attaché in Washington, and he was one of the draughtsmen of the UK-US bilateral air agreement signed in Bermuda in 1946.

One of the Minister's problems is to avoid any loss of the authority which Basil Smallpeice, managing director of BOAC, has achieved during his tenure of office since May 1956. Another problem is the inevitable loss of authority Sir Gerard must experience in view of the fact that his retirement is not formally due until April 30 next year.

In the Commons on April 11 Mr Chetwynd asked Mr Sandys whether, since BOAC's deputy chairman [Sir George Cribbett] was due to retire soon, this was not the right time to appoint a

Seen at Buenos Aires is one of Transcontinental's two Britannia 308s. A note about Argentina's independent appears in col. 1

least a deputy chairman—"perhaps with a view to his taking over as chairman next year." The Minister replied that it was the right time, and that this was what he was doing. But, he said, the choice of deputy chairman was "inevitably linked with other future appointments and it is important to get them right." He hoped the House would forgive a little delay, "because it is better to go slowly and get the correct set-up."

AVRO 748 FOR ADEN AIRWAYS—

IT is understood that the British colonial operator Aden Airways, a wholly owned subsidiary of BOAC operating seven DC-3s and three Argonauts, will take delivery of three Avro 748s. This is the first overseas airline order for Avro's new twin-Dart feederliner. Three have been bought by Skyways, two by BKS, and a large number—the majority of which are to be built under licence—by the Indian Air Force. Delivery will be in 1962.

Aden Airways have been searching for a DC-3 replacement for some years, having at one point been close to ordering the Herald. The company made a profit of about £30,000 in 1958-59.

—AND THE AVRO 748 SERIES 2

ANNOUNCED on the eve of the Hanover Aircraft Show—to be held from tomorrow (April 23) to May 3—is the Avro 748 Series 2. Structurally and internally similar to the earlier aircraft, the Series 2 is fitted with Rolls-Royce Dart RDa.7 Mk 531s each providing 1,910 s.h.p. for take-off. Maximum take-off weight—previously 33,000lb—has now risen to 36,000lb, and continuous cruising speed and range with maximum payload have been increased. The payload represented by 40 passengers and their baggage can be carried 825 n.m. at a cruising altitude of 25,000ft and a cruising t.a.s. of 252kt. This is with reserve fuel for 200 n.m. with 45 minutes' holding at 5,000ft and with a 5 per cent contingency allowance. Installation of RDa.7s is being undertaken to provide for operators who are primarily interested in take-off from hot or high airfields; the Series 2 should achieve a take-off field length at sea level similar to the 3,500ft of the Series 1 but at 3,000lb greater all-up weight. This additional all-up weight has only compromised landing weight very slightly. Series 1 take-off and landing weights are the same and in the Series 2 the landing weight is only 500lb less than take-off weight. Landing distance from 50ft at maximum landing weight—3,250ft—is slightly greater than for the Series 1.

A MATTER OF NATIONAL URGENCY

SINCE the Westland heliport at Battersea was opened nearly a year ago, the volume of traffic has exceeded original expectations. It has been decided to increase the daily hours of availability and to reduce landing fees to frequent users. This was stated by Wg Cdr R. A. C. Brie, of Westland, in a paper presented to the Rotorcraft Section of the Royal Aeronautical Society in London on April 8.

"E" is for Eagle in this striking new Britannia colour scheme (red cheat line, red fin). This aircraft, a 318 leased from Cubana by the British independent, was overhauled and repainted by Bristol Aircraft. Eagle are the fourth UK Britannia operator

Since April 10 the heliport has been open for twelve hours daily except on Sundays, when it is open for five hours. The basic rate for a first landing in any one day will remain at 6s per 1,000lb, but subsequent landing fees during the same day will be reduced by half—or by a greater amount by taking advantage of a "block arrangement."

"As a fact-finding experiment devoid of profit motive, but conforming otherwise to normal commercial practice," says Wg Cdr Brie, "the heliport is not only producing authentic answers to many economic and technical problems concerning the operation of a city heliport, but has stimulated a more general official appreciation and awareness of the rapid approach of the helicopter age."

Wg Cdr Brie warns that the heliport is "a short-term, very temporary solution to the needs of London." But he still adheres to the policy which he has been advocating for twenty years that the River Thames "might still hold the key to a practical economic and operationally acceptable solution to London's central heliport problem." A solution to it, he says, "is a matter of national urgency," and he feels that the Westland Heliport—whatever the ultimate solution is—will have been instrumental in achieving the major objective for which it was created.

BREVITIES

Cambrian Airways re-opened their Cardiff - Bristol - Southampton service on April 8.

The Hamburger Flugzeugbau HFB-314, the firm have said, could be flying within 30 months of a definite development order.

Handley Page recently confirmed to *Flight* that an initial production batch of 25 Heralds is in hand.

The BKS car ferry service between Liverpool and Dublin will come into operation on April 25. A ferry terminal has been built at Dublin.

East Anglian Flying Services have applied to operate ATL-98s on a car ferry service between Bristol and Dublin and Bristol and Cork. An order has not yet been placed and initially Bristol 170s would be used.

A further two Super-G Constellations have been converted to all-freight L.1049H standard for Qantas by Lockheed Aircraft Service. About 10,000 man-hr were required to strip the interior, fit a large rear door and add a cargo floor.

SAA's fleet captain and chief training captain are to leave for Seattle to train on and collect South Africa's first 707. Delivery should be in June or July. Meanwhile, a simulator is being installed at Jan Smuts Airport.

Helicopter services between Newcastle, Sydney, Wollongong and Katoomba are to be operated by a new Australian company, Copter Air Transport. Two S-58s have been ordered and these are to be followed by two 27-seat turbine-powered S-61s.

The Council of the Air Registration Board announce the issue of Notice to Licensed Aircraft Engineers and to Owners of Civil Aircraft No 58 Issue 1 on April 1, 1960. It concerns prohibition of the use of Valetta spares in Vikings.

Capt D. F. O'Sullivan is to be chairman of BALPA for the current year. He succeeds Capt R. T. Merrifield, who has held office since 1957. Vice-chairman will be Capt S. L. Arnold-Boakes, a Viscount training captain with BEA. Capt O'Sullivan is a Britannia training captain with BOAC.

Clarence L. Sayen has been re-elected president of the International Federation of Air Line Pilots Associations.

First deliveries of Irish Air Lines' Boeing 720s will be made on November 1 and services to New York should start on December 15.

PanAm's DC-8s will be the first jets to use Shannon's new 10,000ft runway when they operate on North Atlantic routes from July 1.

Officials of Iraqi Airways have been invited to fly in a Russian Il-18 now in Iraq and three of the type have been offered to the airline.

A new airport, costing about £1m, is to be constructed by Jordan in the Dead Sea area.

Hunting-Clan is to withdraw its fleet from London Airport later this year. As part of British United Airways' fleet the Viscounts will operate from Gatwick and the Britannias from Stansted.

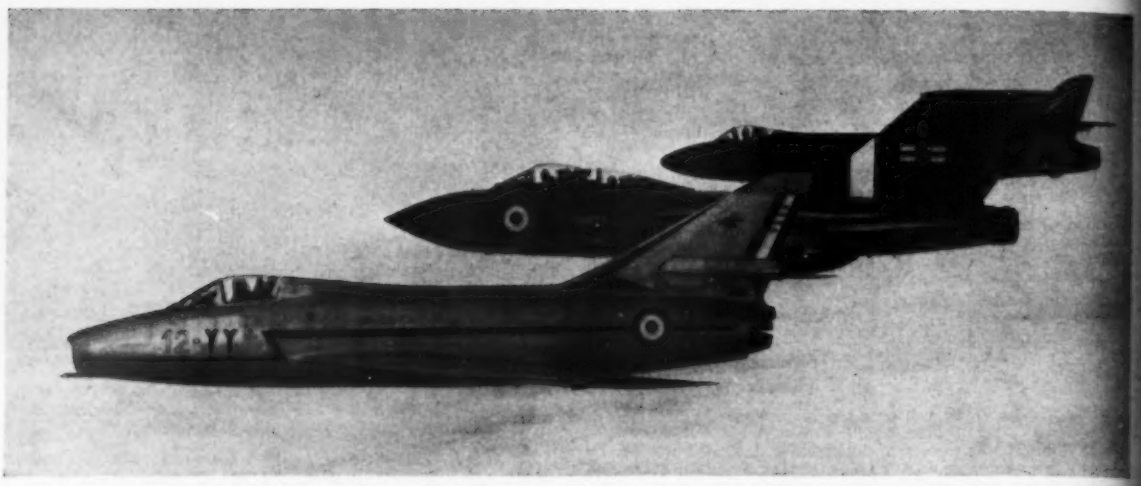
BOAC flights to Cairo were resumed on April 11 after 3½ years. The corporation are to pay £139,400 for desequestration, mainly in indemnities due to former BOAC local staff.

TAA carried just short of a million passengers during the 1959 calendar year, a record for an Australian domestic airline and 12 per cent more than in the previous year.

Air-India's Boeing 707-420 left for New York on the first of a series of joint AII-BOAC proving flights on April 7. Boeing 707 services to India start on April 20.

An investigation is to be held into the possibility that the accident to the KLM Super Constellation 100 miles off Shannon in August 1958 was caused by sabotage. A number of technical questions are also to be re-examined.

The FAA is proposing a rule whereby all obstacles in an area two, four and six thousand feet from the end of the runway—depending upon weather conditions and other factors—would have to be considered in planning a take off. The present rule requires 300ft horizontal clearance and a specified vertical clearance—a 600ft wide area about the centre-line of the aircraft's take-off path.



A Super-Mystère of No 12 Wing of the French Air Force with a Javelin FAW.8 of No 41 Sqn and a Hunter F.6 of No 111 Sqn. The Javelin bears a red Cross of Lorraine on a white ground, the marking No 41 Sqn adopted from St Omer, where it was based during the First World War

SERVICE AVIATION

Air Force, Naval and Army Flying News

CAS on Tour

AT the invitation of the Royal Rhodesian Air Force the Chief of the Air Staff, Air Chief Marshal Sir Thomas Pike, is paying them a visit. His overseas tour, being made in a Comet 2 of No 216 Sqn, began last Tuesday; he is also visiting RAF units at Gibraltar and Malta and is returning to the UK on April 28.

Bracknell to Whitehall

FROM the beginning of next month Air Cdre J. R. Gordon-Finlayson is to be Director-General of Personal Services at Air Ministry, with the acting rank of air vice-marshal. He has been Assistant Commandant of the RAF Staff College at Bracknell since December 1956, and before that was Group Captain in charge of Organization at Bomber Command headquarters. For his services in Greece during 1940-41, when he flew over a hundred operational sorties, Air Cdre Gordon-Finlayson was awarded the DSO and DFC.

Britannics and Belvederes

WHEN the Lords debated the Air Estimates recently a strong plea for integration of Transport Command with the Army was made by Field Marshal Lord Harding. He said that unless the Command wedded the Army in a happy marriage the whole defence system would pay the penalty—there would be great waste of men, money and material. Lord Harding called for a ten-year development plan for Transport Command. The Army's requirement, he said, was as much for carrying freight as for carrying men. Referring to the transport of 200 vehicles by air in a recent exercise, he said that even such a total for all purposes was insufficient to give full practical and administrative mobility to the number of troops involved. Not until the Britannic came into service would the RAF be able to lift everything that came to hand. Lord Harding said he was particularly concerned about the provision of freight-carrying aircraft and helicopters. A ten-year development plan for Transport Command would be of tremendous value to the War Office and the Army in training programmes.

Speaking for the Government, Lord Carrington mentioned that since 1955 the capacity of Transport Command had been trebled. This year, the first Bristol Belvederes were entering service and orders were being placed for the new turbine-engined Whirlwind. This would more than treble the helicopter lift at present available to the Army.

Rescue Attempt Commended

FOR his courage, determination and devotion to duty during an air/sea rescue operation in the German Bight area of the North Sea in November last year, Flt Lt R. G. R. Ireland-Blackburne has been awarded the Queen's Commendation for Brave Conduct. In a search for a missing Hunter from Jever in a full south-west gale, Flt Lt Ireland-Blackburne took his launch some 95 miles out to sea then continued the search for 11 hours, using the vessel as a floating communications centre for the 100 aircraft from the RAF and the German and Dutch and Danish Air Forces combing the area. The whole crew were commended after the search by the Commander-in-Chief RAF Germany, Air Marshal Sir Humphrey Edwardes Jones.

Exercise Signal Fire

NEARLY 14,000 members of the Royal Observer Corps were on duty during the weekend of April 9-10 for Signal Fire, a NATO exercise in the measurement and reporting of radioactive fallout. Co-operating with the United Kingdom were the equivalent monitoring organizations in Norway, Denmark, Holland and France.

In Britain, synthetic fallout readings were reported from about 1,500 Observer Corps posts, covering most of the country, to the Home Office warning organization. Here some 600 people analysed the reports and prepared elaborate charts indicating the extent and intensity of fallout from several nuclear explosions of varying intensity. Great care was taken to ensure a realistic spread of fallout. Meteorological records for the past ten years were averaged to provide the weather on which the exercise was based.

It was cold and drizzling when I visited Post Bravo One (writes a correspondent), on top of a telephone exchange in north London. I expected to find the crew of two tired but still keen after nearly 8 hours' continuous night duty; but the post was empty. Then I realized that because it was a fallout exercise they would be reporting from a room inside the building under conditions more related to this kind of duty. This brought home forcibly the wind of change which is blowing through the ROC and helped remind me that nearly 200 posts were operating for the first time from their new underground structures. Officially termed "protected accommodation," these are designed to house an observer team for several days on a self-supporting basis.

In Brief

No 66 Sqn, based at Acklington, is to be disbanded later this year and Fighter Command will then give up the station.

Six Banshees of VF 870 Sqn of the Royal Canadian Navy shot down five Firefly target aircraft out of six with Sidewinders in recent trials at the RAE missile range at Aberporth.

No 26 Sqn, winners for 1959 of the Duncan Trophy (awarded annually for air firing by RAF fighter squadrons in Germany), say it is anticipated that the Duke of Gloucester will make the presentation at Gutersloh on May 12.

Glasgow UAS won the Scone Trophy, which is competed for annually by the four Scottish university air squadrons, at Scone recently and now go forward to participate in the Hack Trophy competition. Members of the winning team were Acting Plt Off D. A. Cameron (aerobatics), Cdt Plt R. Miller (spot landing) and Cdt Plt D. R. Ruddick (forced landing).

The tenth reunion dinner of No 194 Sqn (India-Burma-Malaya) will be held at the Tavistock Banqueting Rooms, 18 Charing Cross Road, London WC2, on Saturday, May 14, at 6.30 for 7.30 p.m. The guest of honour will be Vera Lynn. Tickets (18s 6d) may be obtained from the hon secretary, Douglas Williams, 56 Mottingham Lane, Lee, London SE12 (tel Lee 1025).